DOCUMENT RESUME

ED 279 507 SE 047 772

AUTHOR Conway, Lorraine
TITLE Learning about Oceanography. Superific Science Book VII. A Good Apple Science Activity Book for Grades 5-8+.
REPORT NO ISBN-0-86653-066-5
PUB DATE 82
NOTE 73p.
AVAILABLE FROM Good Apple, Inc., Box 299, Carthage, IL 62321-0299 (GA401; $5.95).
PUB TYPE Guides - Classroom Use - Guides (For Teachers) (052)

EDRS PRICE MF01 Plus Postage. PC Not Available from EDRS.
DESCRIPTORS Earth Science; Ecology; Elementary Education; *Elementary School Science; Environmental Education; Experiential Learning; Intermediate Grades; Junior High Schools; *Marine Education; *Oceanography; *Science Activities; Science Education; Science Equipment; *Science Experiments; *Science Instruction; Water Resources

ABSTRACT

Based upon the recognition that the sea has great potential as a future source of energy, minerals, and water, this document was developed to provide students with learning experiences in oceanography. It contains background information about ocean tides, waves, chemistry, depths, and plant and animal life. The book provides the teacher with hands-on activities, experiments, drawings, and worksheet exercises that deal with such subjects as: (1) the topography of the sea; (2) ocean currents; (3) finding places by means of latitude and longitude; (4) salt from seawater; (5) ions in seawater; (6) a test for the chloride ion; (7) waves; (8) how depth affects water pressure; (9) making drift bottles and secchi discs; (10) measuring ocean depths and speed; (11) nautical terms; (12) icebergs; (13) the Titanic's message in radio code; (14) sailor's jargon; (15) endangered species of the sea; and (16) careers in oceanography. Included is a student certificate for being involved in the oceanography activities, reproducible handouts and quizzes, and an answer key. (TW)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

A Good GA Apple Science Activity Book for Grades 5-8 +

SUPERIFIC SCIENCE

BOOK VII

Learning About Oceanography

ED279507

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

☒ This document has been reproduced as received from the person or organization originating it.

☐ Minor changes have been made to improve reproduction quality.

• Points of view or opinions stated in this document do not necessarily represent official OERI position or policy.

SE 047 773

Written by Lorraine Conway

Illustrated by Linda Akins

2

"PERMISSION TO REPRODUCE THIS MATERIAL IN MICROFICHE ONLY HAS BEEN GRANTED BY

Jerry Otter

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

SUPERIFIC SCIENCE

OCEANOGRAPHY

by
LORRAINE CONWAY

Illustrated by Linda Akins

Cover illustrated by Nancee Volpe

Copyright © Good Apple, Inc. 1982

GOOD APPLE, INC.
BOX 299
CARTHAGE, IL 62321-0299

All Rights Reserved--Printed in United States of America by Crest Litho Inc., Albany, New York

Copyright © Good Apple, Inc. 1982

ISBN No. 0-86653-066-5

Printing No. 98765432

The purchase of this book entitles the buyer to duplicate the student activity pages as needed, for use by students in the buyer's classroom. All ideas and illustrations may also be used by the buyer in the buyer's classroom. Permission for any other use must be granted by Good Apple, Inc.

GOOD APPLE, INC.
BOX 299
CARTHAGE, IL 62321-0299

4

INTRODUCTION

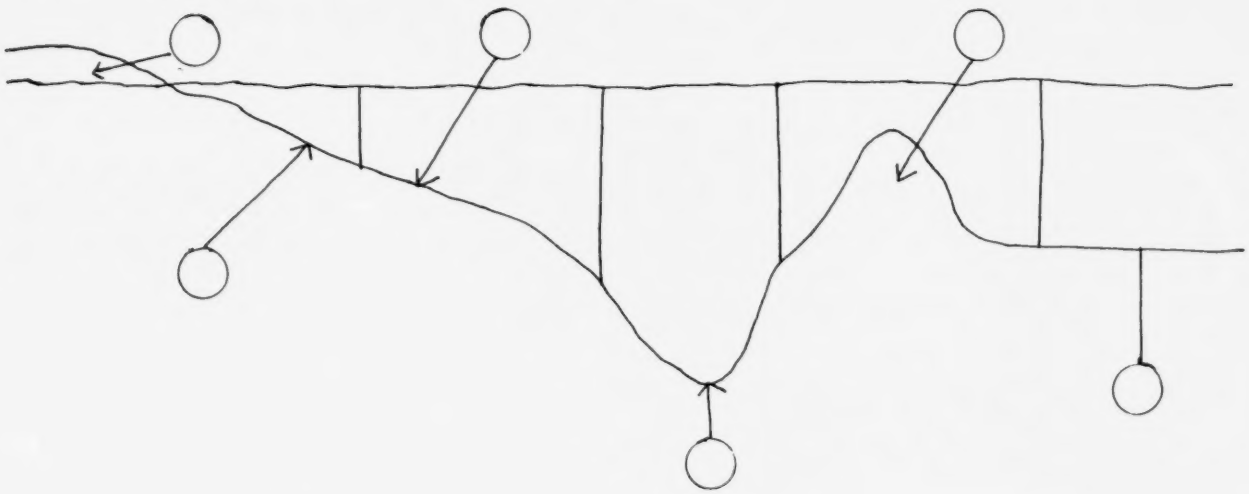
Oceanography is a book designed as an introduction to an area of study which is assuming greater importance each day. More and more we are looking to the sea to supply us with food for the world's expanding populations, as an energy source to supply our rising needs, as a water source to supplement our continuing demands, and as an untapped reservoir of great mineral wealth. In order to derive these benefits, we must first understand our oceans-their tides, waves, chemistry, depths, plant and animal life along with other involved areas of study. To begin this study, this book uses experiments, drawings, hands-on activities and exercises that inform, challenge, and motivate.

TABLE OF CONTENTS

ACTIVITY	PAGE
The Topography of the Sea	1
In Which Ocean Is the Ship Sailing?	2
Ocean Currents	4
Latitude and Longitude	6
Finding Places by Means of Latitude and Longitude	7
Prefixes Used in Oceanography	9
How Much Salt Is There in Ocean Water?	10
Float an Egg in Salt Water	11
Salt from Seawater	12
What Keeps the Oceans from Freezing?	13
Ions in Seawater	15
A Test for the Chloride Ion	16
Waves	17
Does Water Bend Light?	19
Core Sample	20
How Does Depth Affect Water Pressure?	21
Sea Stings	22
Make a Drift Bottle	24
Measuring Ocean Depths and Speed	26
Secchi Disc	27
Tides	30
How Ocean Depth Is Measured by Sounding	33
Nautical Terms	36
The Unsolved Mystery of the *Mary Celeste*	37
Icebergs	38
A Ship of Contradictions	39
The *Titanic's* Message in Radio Code	41
Barracuda External	42
Barracuda Internal	44
Buoys	46
Sailors' Jargon	47
Make a Simple Periscope	48
Endangered Species of the Sea	50
Careers in Oceanography	53
Award	56
Answer Key	57

THE TOPOGRAPHY OF THE SEA

The shape of the earth, its mountains, valleys, and plains are called its topography. These features also occur under the oceans and are called the topography of the ocean floor. This land under the sea is marked by many interesting features, such as a trench so deep Mount Everest could be submerged in it. There are also vast plains, mountain ranges, and slopes. To see how well you can recognize these features, try to match the description to the drawing by writing in the correct number answer of the description in the circle on the drawing.



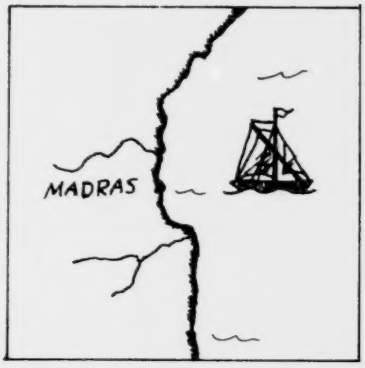
1. The continental shelf or the gently sloping plain extending from the land into the sea
2. A ridge or mountain range under the sea
3. A trench or deepest depth in the ocean
4. The shore or land around the ocean's edge
5. The abyssal plain or the large, flat, deep areas on the ocean's floor
6. The continental slope or the steep slope leading to the ocean's floor

IN WHICH OCEAN IS THE SHIP SAILING?

Can you tell by seeing a small portion of the map of the world in which ocean the ship is sailing? Try your skill on the following maps. Use a globe or world map to check your answers.

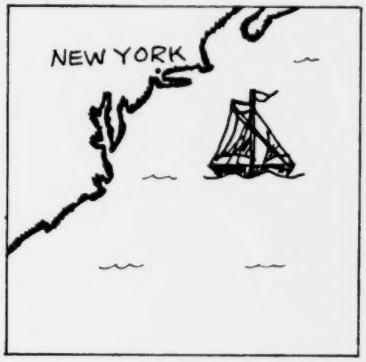
a. _____

b. _____

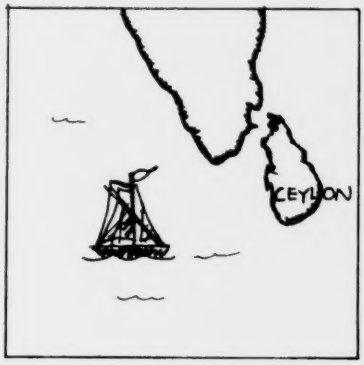


c. _____

d. _____



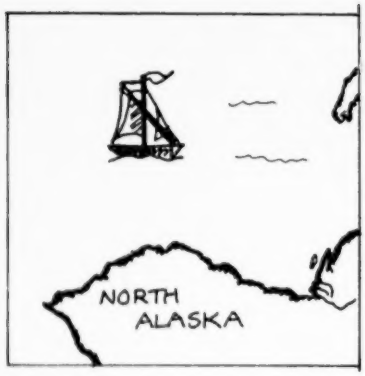
e. _____



f. _____

TOKYO

g. _____


NORTH
ALASKA

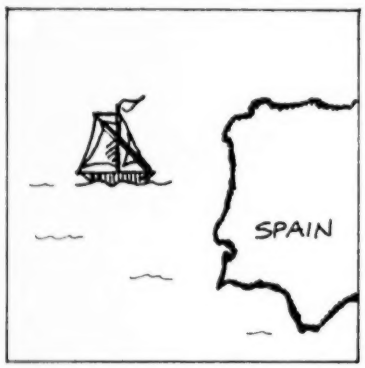
h. _____

LOS ANGELES

i. _____

SINGAPORE
SUMATRA

j. _____


SPAIN

k. _____

IRELAND

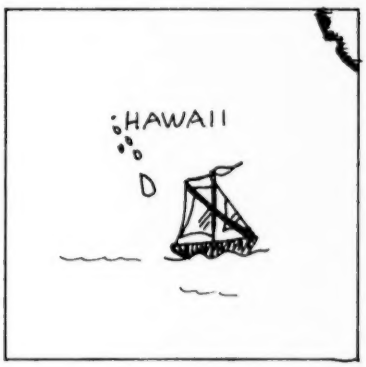
l. _____

NORWAY

m. _____

GREENLAND

n. _____

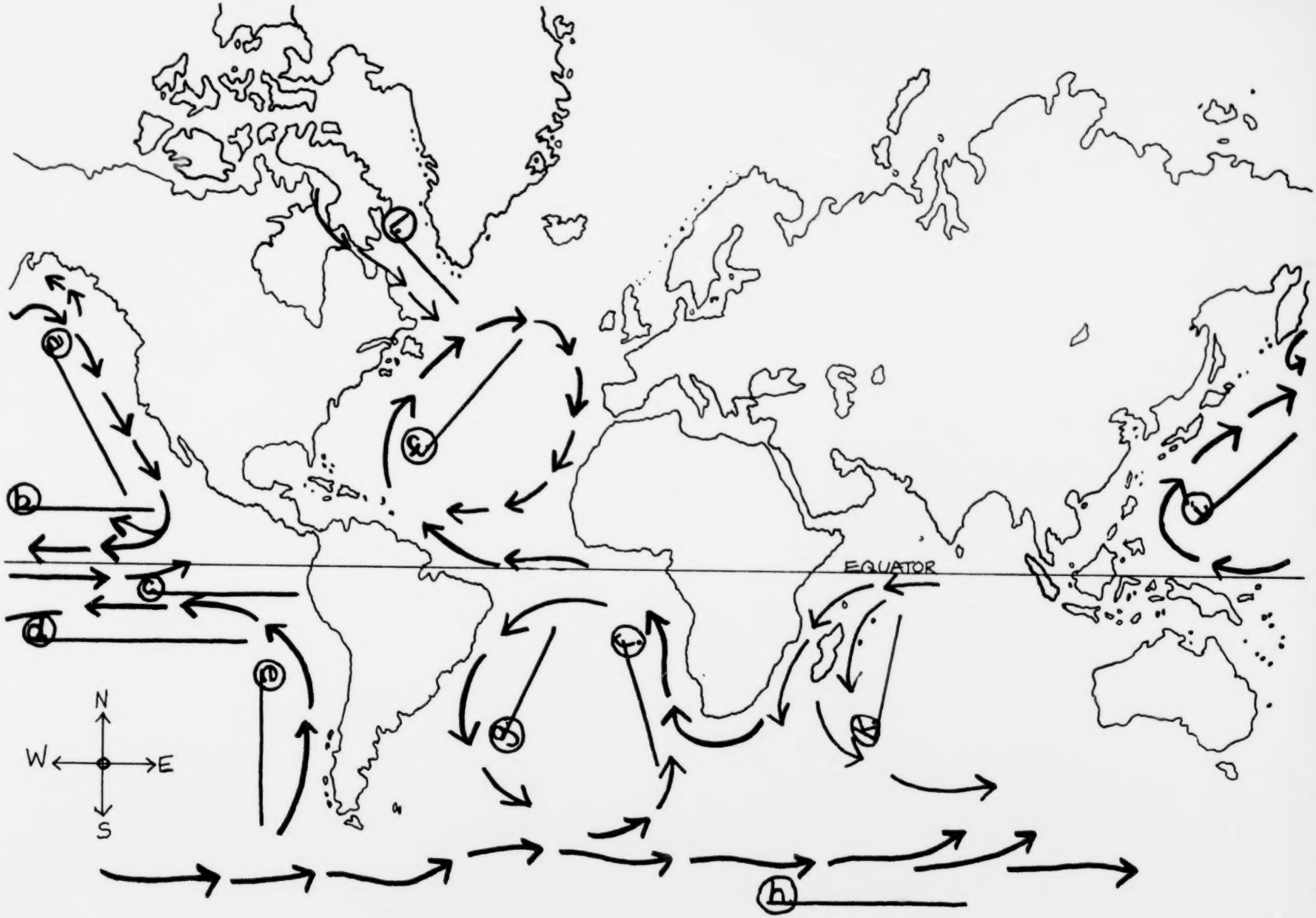

HAWAII

o. _____

OCEAN CURRENTS

Scientists believe that ocean surface currents are caused by winds which prevail in that region. Below are descriptions of some of the major ocean currents; use this information to label the currents on the map drawn on page 5. Use a globe or world map if needed.

1. The Gulf Stream Current in the Northern Hemisphere flows north along the eastern coast of the United States in a clockwise direction, bringing warm water along its course.
2. In the Southern Hemisphere the Humbolt Current (Peru Current) travels north bringing cold water along the western coast of South America, traveling in a counterclockwise direction.
3. The Kuroshio Current (Japan Current), which is in the Northern Hemisphere, runs clockwise along the eastern coast of Japan bringing cool waters to the coast of California, where it becomes part of the California Current.
4. The West Wind Drift is a cold current traveling from west to east which circles Antarctica in the Southern Hemisphere.
5. The North Equatorial Current in the Pacific Ocean runs clockwise just above the equator in the Northern Hemisphere; it later joins the Kuroshio Current.
6. The South Equatorial Current in the Southern Hemisphere runs counterclockwise just below the equator.
7. The Equatorial Counter Current runs west to east between the North and South Equatorial Currents.
8. The Brazilian Current in the Southern Hemisphere runs counterclockwise along the coast of South America.
9. Running clockwise in the Northern Hemisphere, the California Current travels along the western coast of the United States.
10. The Benguela Current runs counterclockwise along the west coast of Africa.
11. The Agulhas Current in the Southern Hemisphere travels counterclockwise along the east coast of Africa. It continues southward along the east and west coasts of Madagascar to the tip of Africa.
12. In the Northern Hemisphere the Labrador Current travels south bringing its cold waters to the east coast of Canada. It intermingles and cools the warmer Gulf Stream Current in the North Atlantic.

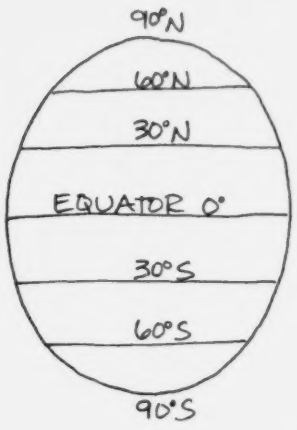


11

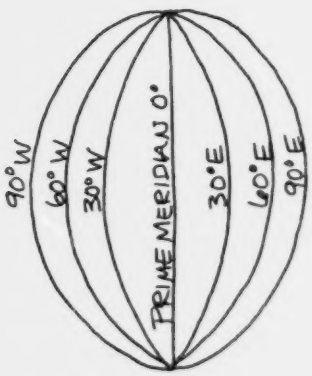
12

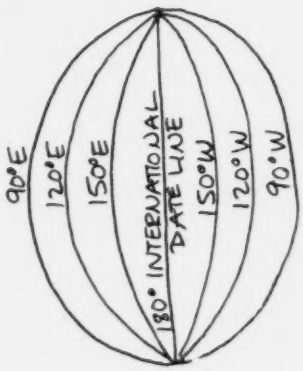
LATITUDE AND LONGITUDE

Locating places on the globe is made easier by means of imaginary lines. The lines which go around the globe from east to west are called latitude. Latitude is written in degrees (°) north or south of the equator. The equator is 0° latitude. The North Pole is 90° north latitude and the South Pole is 90° south latitude.



Lines drawn north to south on the earth are called lines of longitude. They begin with the prime meridian which runs through Greenwich, England. The prime meridian is 0° longitude. Lines to the right of the prime meridian are measured in degrees east, and lines of longitude to the left of the prime meridian are measured in degrees west until 180° longitude is reached. This is the International Date Line; it is halfway across the world from Greenwich.





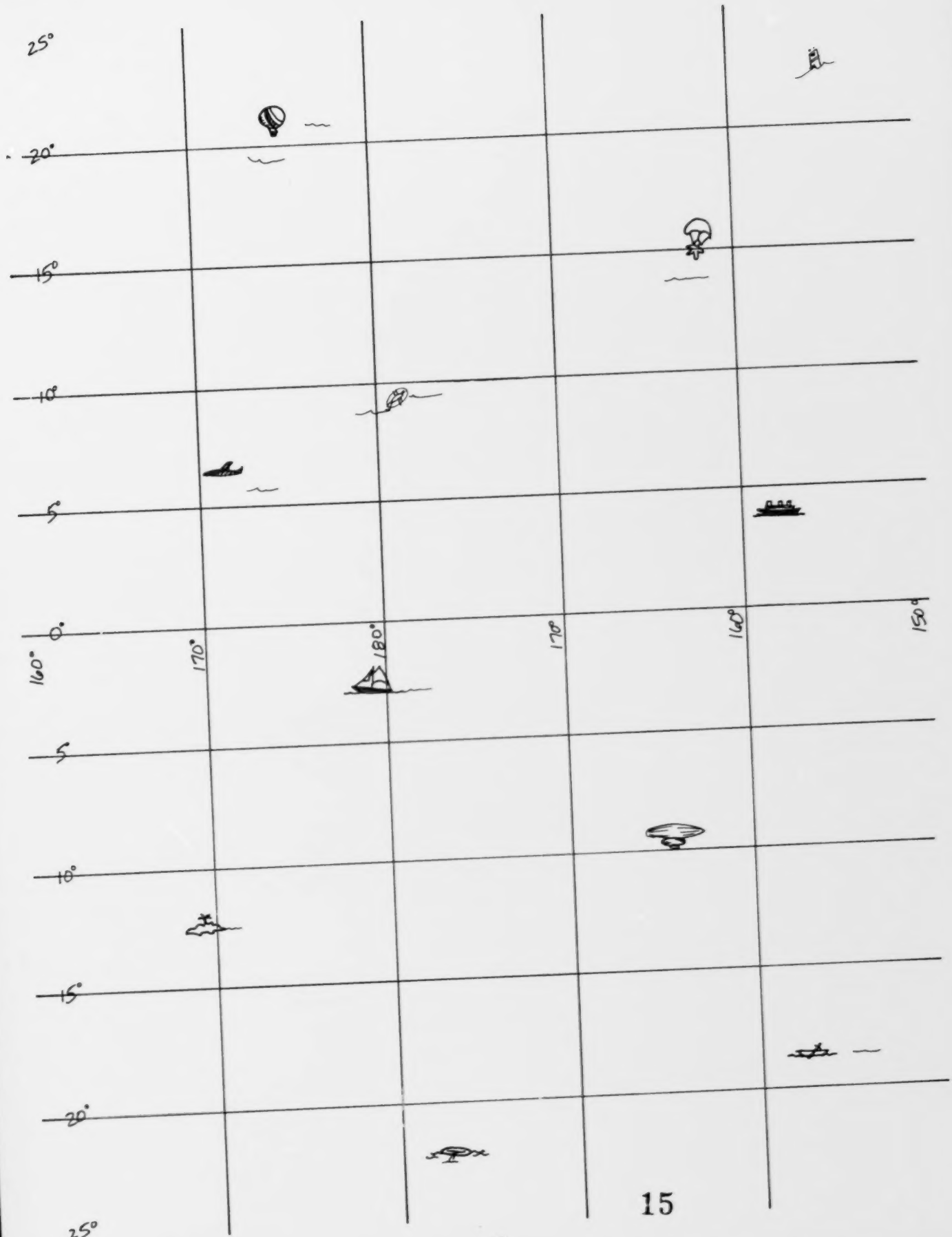
FINDING PLACES BY MEANS OF LATITUDE AND LONGITUDE

Using the imaginary map on the next page, locate by means of latitude and longitude the following places and objects:

1. Hot air balloon — Latitude _____ Longitude _____
2. Parachute — Latitude _____ Longitude _____
3. Rowboat — Latitude _____ Longitude _____
4. Lifesaver — Latitude _____ Longitude _____
5. Island — Latitude _____ Longitude _____
6. Airplane — Latitude _____ Longitude _____
7. Blimp — Latitude _____ Longitude _____
8. Sailboat — Latitude _____ Longitude _____
9. Buoy — Latitude _____ Longitude _____
10. Life raft — Latitude _____ Longitude _____
11. Ocean liner — Latitude _____ Longitude _____

QUESTIONS:

1. The prime meridian is also termed _____.
2. The equator can also be termed _____.
3. 180° longitude is another way to express the _____.
4. Lines going around the globe from east to west are called _____.
5. Lines running north and south on the globe are called _____.
6. A plane landed at 90° north latitude. Where was it? _____.



15

PREFIXES USED IN OCEANOGRAPHY

Hydro	water
Sub	under
Photo	light
Chloro	green
In	not
Uni	one
Bi	two
Phyto	plant
Aqua	water
Zoo	animal

By referring to the above prefixes, complete the pargraph below. A word in the sentence preceding the blank will aid you in making the correct choice.

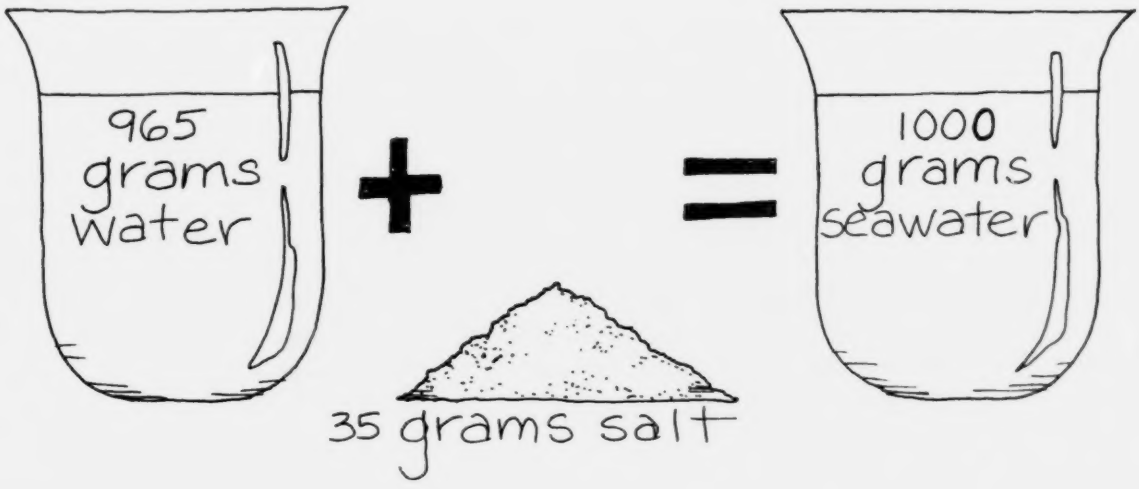
The oceans and all other bodies of water on earth are known as the _____ sphere. In the oceans there are billions of tiny plants that drift with the currents and are called _____ plankton. Many of these are green due to _____ phyll, which in the presence of sunlight enables the plant to make food and oxygen in a process called _____ synthesis. The tiny animals which drift with the currents are called _____ plankton. They serve as an important food source for many fish along with a variety of other animals that do not have backbones, the _____ vertebrates. Some of these are snail-like animals possessing one shell and are known as the _____ valves; others have two shells and are known as the _____ valves, such as oysters and the clams. Underwater divers, or _____ nauts, explore many of these secrets at great depths in the vessels called _____ marines.

HOW MUCH SALT IS THERE IN OCEAN WATER?

The amount of salt in the oceans varies greatly from one place to another. Ocean water is less salty (saline) where it is diluted with fresh water, as it is near the mouths of the great rivers. Precipitation such as rain also dilutes ocean water, as does the melting of icebergs. The salinity (saltiness) increases where there is much evaporation and little rain. In general, hot, dry areas of the ocean will have a higher concentration of salt. The average amount of salt in ocean water is about 35 grams per liter (1.06 qts).

MATERIALS: Beaker, water, salt, scale

PROCEDURE: In 965 grams of water dissolve 35 grams of salt.

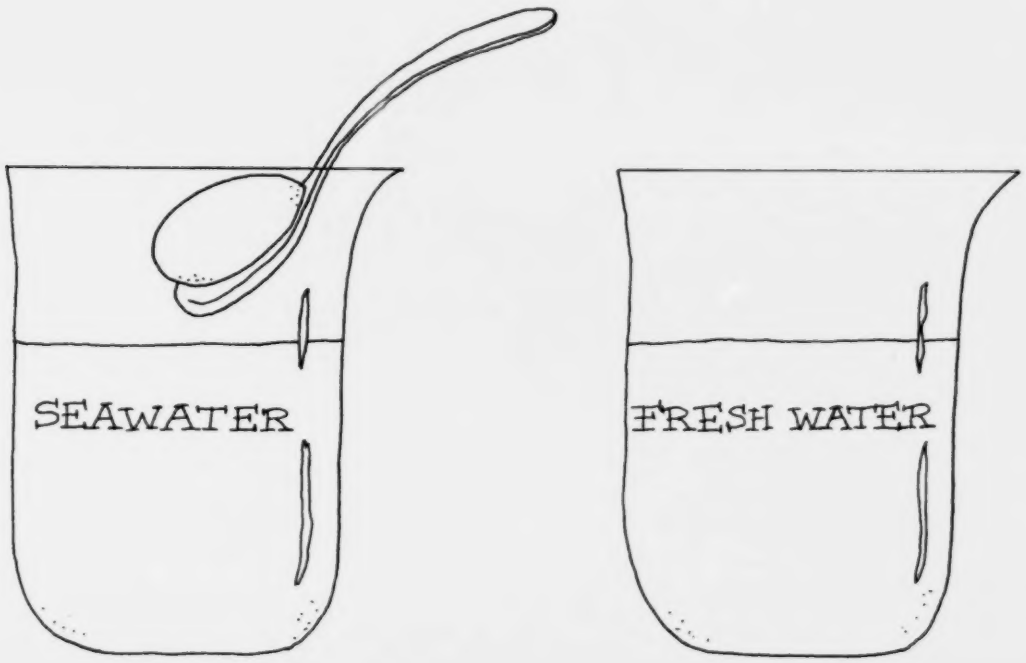


Use this method of making salt water in the following experiments where salt water is required.

FLOAT AN EGG IN SALT WATER

There are bodies of salt water where the amount of salt is so great that people float effortlessly in them. The Great Salt Lake and the Dead Sea are two examples. The Dead Sea is the saltiest body of water in the world; it is about seven times saltier than ordinary ocean water. To show how salt adds buoyancy to water, do the following experiment:

MATERIALS: Two beakers, two eggs, fresh water, seawater (35 grams of salt in 965 grams of fresh water).



PROCEDURE: After you have made seawater, fill two beakers, one with fresh water, the other with the seawater. Place an egg in each.

1. Describe the results. _____

_____

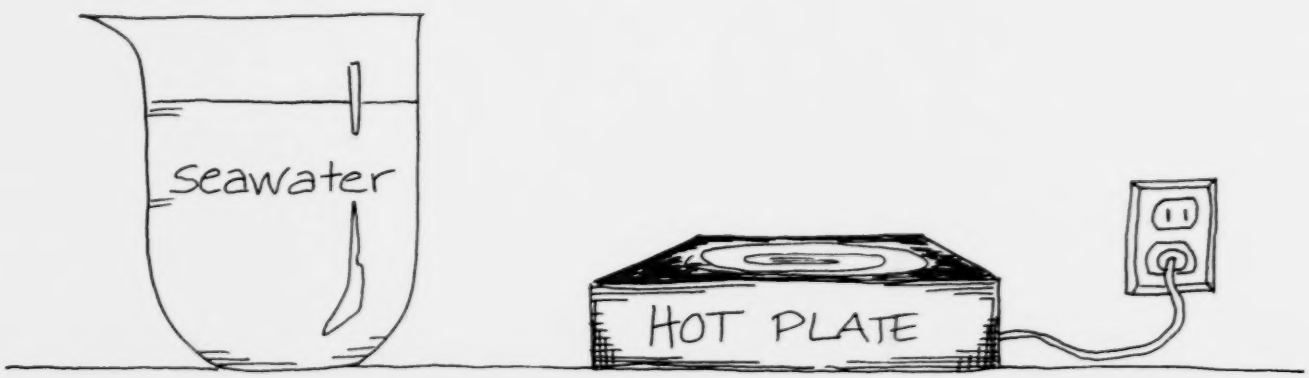
2. If you wished to make seawater with the salt concentration of the Dead Sea, how much salt would you use? _____

SALT FROM SEAWATER

With increasing demand for fresh water in many parts of the world, the removal of salt from seawater has become necessary in some places in order to provide a sufficient supply of fresh water. Although it is a simple process, extracting fresh water from seawater on a large scale is very costly. Seawater is first heated, then the steam is boiled off and condensed into fresh water, leaving the salt. In this way two products are obtained.

PURPOSE: To demonstrate the removal of salt from seawater.

MATERIALS: Seawater, Pyrex beaker, heat source (bunsen burner, alcohol lamp, hot plate, etc.), scale.



PROCEDURE: Make seawater by adding 35 grams of salt to 965 grams of water. Stir until salt is dissolved. Heat gently until all the water is boiled off. The water may be allowed to evaporate naturally in the room, or it can be placed near a radiator to speed up the natural evaporation. When all the water has evaporated, scrape the remains and weigh.

1. How much salt was added to make seawater? _____
2. How much salt was left after evaporation? _____
3. Which process did you eliminate in your experiment that would be done when fresh water is extracted from seawater commercially?

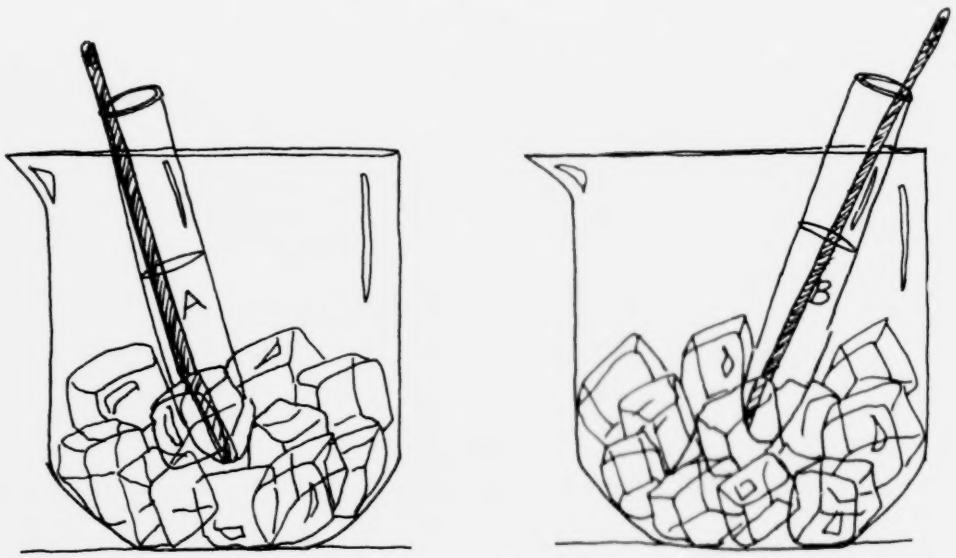
WHAT KEEPS THE OCEANS FROM FREEZING?

PURPOSE: To find out why the oceans do not freeze, do the following experiment.

MATERIALS: Salt water*, fresh water, salt, ice, two beakers, two test tubes, and two thermometers.

PROCEDURE: Half fill one test tube with saltwater and label it A. Half fill the other test tube with fresh water and label it B. Place thermometers in each. Put the test tubes in the beakers and surround with ice cubes. Pour several tablespoons of salt over the ice cubes. Record the temperatures of each thermometer at 15 minute intervals.

	15 Min.	30 Min.	45 Min.
A			
B			



*To make a salt solution similar to ocean water, mix 35 grams of salt in 965 grams (a little less than a quart) of water.

1. At what temperature does the water in test tube A begin to freeze? _____

2. How long did it take for the water in test tube A to begin freezing? _____

3. At what temperature does the water in test tube B begin to freeze? _____

4. How long did it take for the water in test tube B to begin to freeze? _____

5. What is the only apparent difference between test tube A and test tube B? _____

6. Write a statement concerning one factor which keeps seawater from freezing.

7. Do you think the factor in your statement is the only reason seawater does not freeze? _____

8. What other factors might keep the oceans from freezing? _____

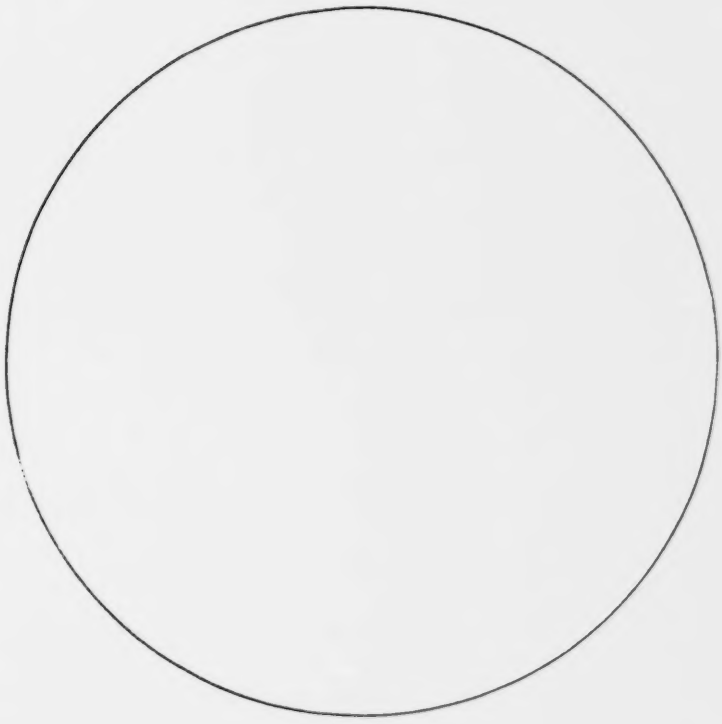
9. Are there places in which ocean water does freeze? _____

10. Where would you expect ocean water to freeze? _____

11. Is it possible that if the temperature became cold enough more of the oceans would freeze? _____

12. What evidence do we have of this happening? _____

IONS IN SEAWATER



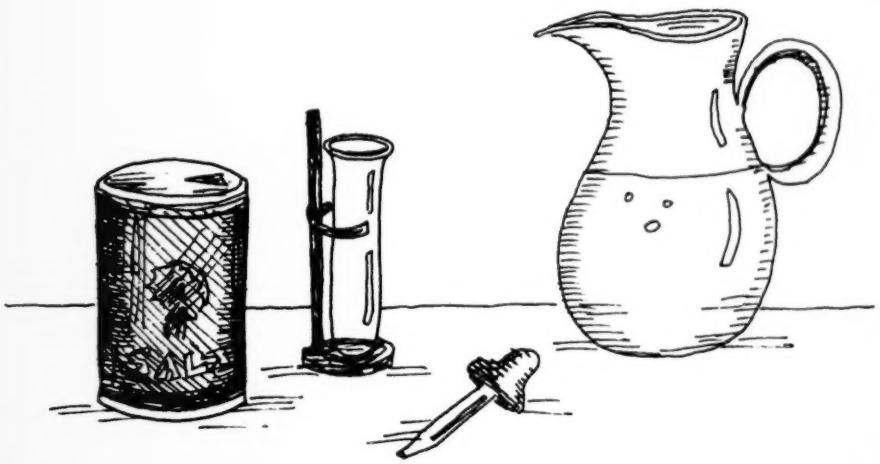
The most plentiful ions (charged particles) found in the sea are chlorine, sodium, sulfate, magnesium, and potassium. They are always found in the same percentage of the total amount of dissolved solids. Using the figures below,construct a circle graph showing the six most abundant ions found in seawater.

ION	ION PERCENT OF TOTAL DISSOLVED SOLIDS BY WEIGHT
Chlorine	55.2%
Sodium	30.4%
Sulfate	7.7%
Magnesium	3.7%
Calcium	1.2%
Potassium	1.1%
All others	.7%
Total	**100.0%**

A TEST FOR THE CHLORIDE ION

PURPOSE: This is a simple chemical experiment which can easily be done to test salt water for the chloride ion (a charged particle).

MATERIALS: Table salt (sodium chloride), water, test tube, medicine dropper, silver nitrate.



PROCEDURE: Pour 25 to 30 milliliters of water into a test tube. Add a few grams (three or four) of salt. Shake to dissolve. Cautiously add two or three drops of silver nitrate. (Silver nitrate stains; do not get it on your hands or clothes.)

Describe the chemical reaction. _____

_____

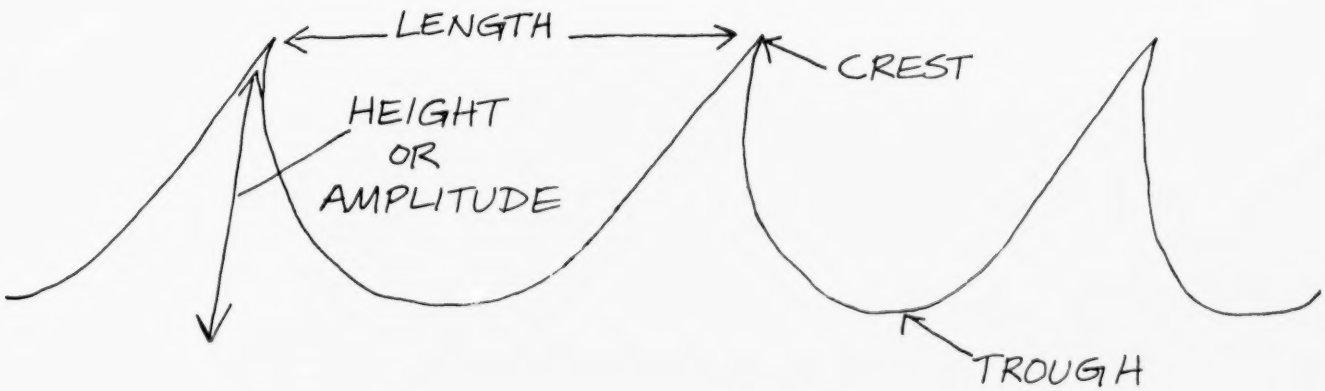
_____

_____

_____

WAVES

The study of waves is an important part of oceanography. Surface waves are caused by winds. As the wind continues to blow over the water, provided the distance is great enough, the size of the wave increases. The top of the wave is called its crest. The lowest part of a wave is its trough. The distance between the crest and the trough is called height or amplitude. The wavelength is the distance between the crest of one wave to the next.



The frequency is the number of waves that pass a given point in a given amount of time. The formula for frequency is:

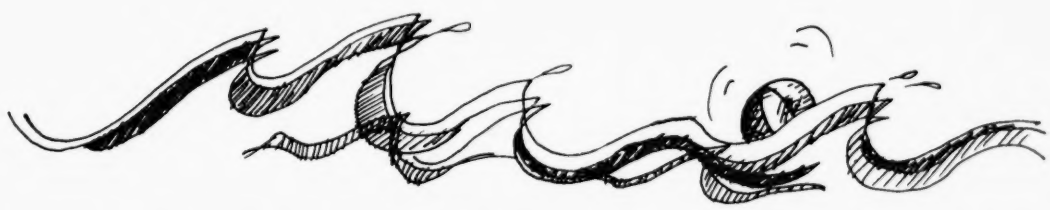
$$F = \frac{\text{number of waves}}{\text{time in seconds}}$$

The period is the time it takes for two successive wave crests to pass the same point. The formula for a wave period is:

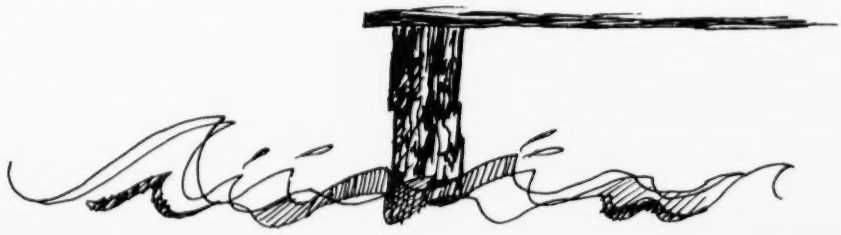
$$P = \frac{\text{time in seconds}}{\text{number of wave crests}}$$

Use the above information to solve the problems on the next page.

WAVE PROBLEMS



1. A beach ball floating in the ocean rises and falls 20 times in 40 seconds. What is the frequency of the waves?

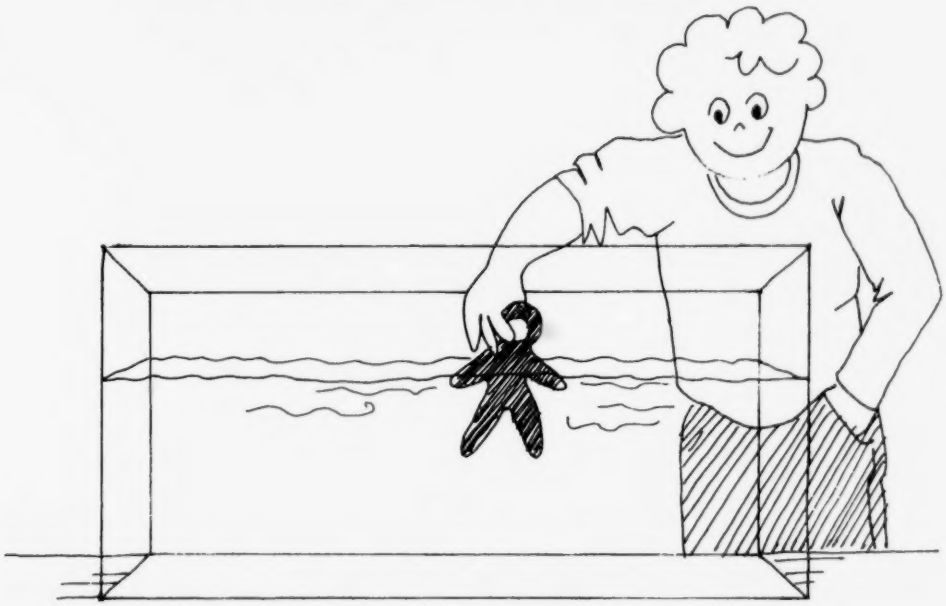


2. In 60 seconds 20 wave crests pass a pole supporting a dock. What is the period of these waves?

3. A boy watches his toy boat go up and down 45 times in 15 seconds. What is the frequency of the wave observed by the boy?

4. During a storm the crests of 50 waves pass a bell buoy in one minute. What is the period of the waves?

DOES WATER BEND LIGHT?



PURPOSE: To determine whether or not water bends light.

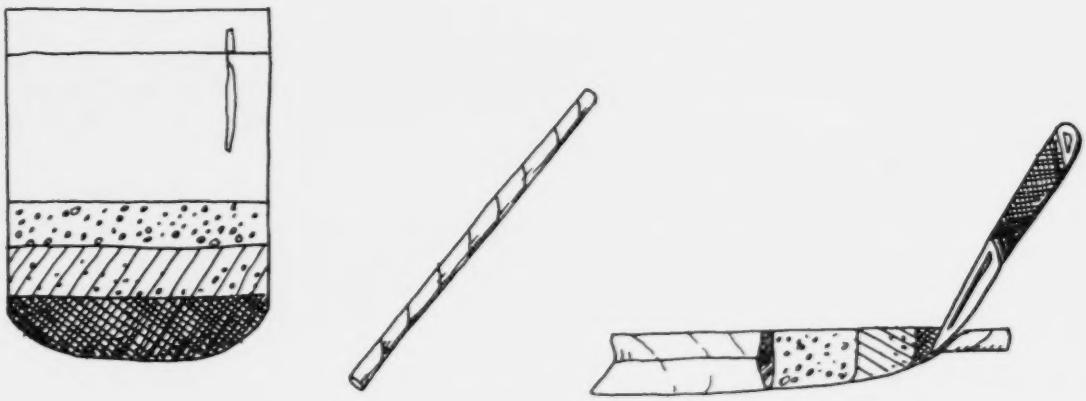
MATERIALS: Cardboard or plastic-laminated cardboard, pencil, scissors, aquarium, water.

PROCEDURE: Use stiff cardboard to cut out the figure of a diver. Have one student hold the diver part way into the tank of water. Other students will observe the diver at various angles and levels. Have students write a conclusion.

CONCLUSION: _____

CORE SAMPLE

Oceanographic geologists study the ocean's floor by means of core samples taken by a machine called a corer. These samples are carefully collected and studied; they tell a story in sediments and rock millions of years old. To learn something of how this is done, do the following experiment:

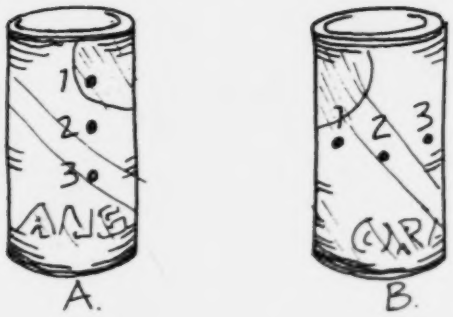


PURPOSE: To learn how the ocean's floor is studied by geologists.

MATERIALS: Materials to be used as sediments, such a variety of soils, sand, red clay, etc., large beaker or other suitable container, drinking straw, razor blade. (Test tube can be used in place of the straw, thereby eliminating the use of a razor blade if students are doing the experiment.)

PROCEDURE: Layer the varieties of soil and sediments. Cover with water and allow to settle. Gently twist the straw into the sediments. Cut the straw carefully to show the layers. If a test tube is used be careful when pushing into the sediments that it does not break in your hand.

HOW DOES DEPTH AFFECT WATER PRESSURE?



PURPOSE: To show how depth affects pressure.

MATERIALS: Two tall juice or coffee cans, nail, hammer, large cake pan or tray to catch water, ruler.

PROCEDURE: Using the hammer and nail, punch three holes in can A as shown and three holes in can B as shown. Place cans in large cake pan or over sink and add water first to can A and then to can B. Measure the distance the water spurts from each hole. Fill in tables and answer the questions.

CAN A	DISTANCE	CAN B	DISTANCE
1st hole		1st hole	
2nd hole		2nd hole	
3rd hole		3rd hole	

QUESTIONS:

1. What reasons can you give for the difference in the water spurted from the three holes in the two cans?
2. From which hole was the pressure greatest? Why?
3. From which hole was the pressure least? Why?
4. Which four holes had similar pressure? Why?
5. What does this experiment tell about water pressure in the oceans?

SEA STINGS

The sea anemone is a hollow-bodied animal. (In color a sea anemone may be blue, green, red or another brilliant color.) Surrounding its mouth are many tentacles equipped with stinging cells which paralyze the small fishes it feeds upon. The immediate effect of its sting on man is severe pain.

The Portuguese man-of-war is not a single animal but a floating colony of jellyfish. Its pretty, but deadly, floating sac is filled with gas. Long tentacles which may reach lengths of one hundred feet are lined with stinging cells that paralyze on contact. Its sting can be fatal.

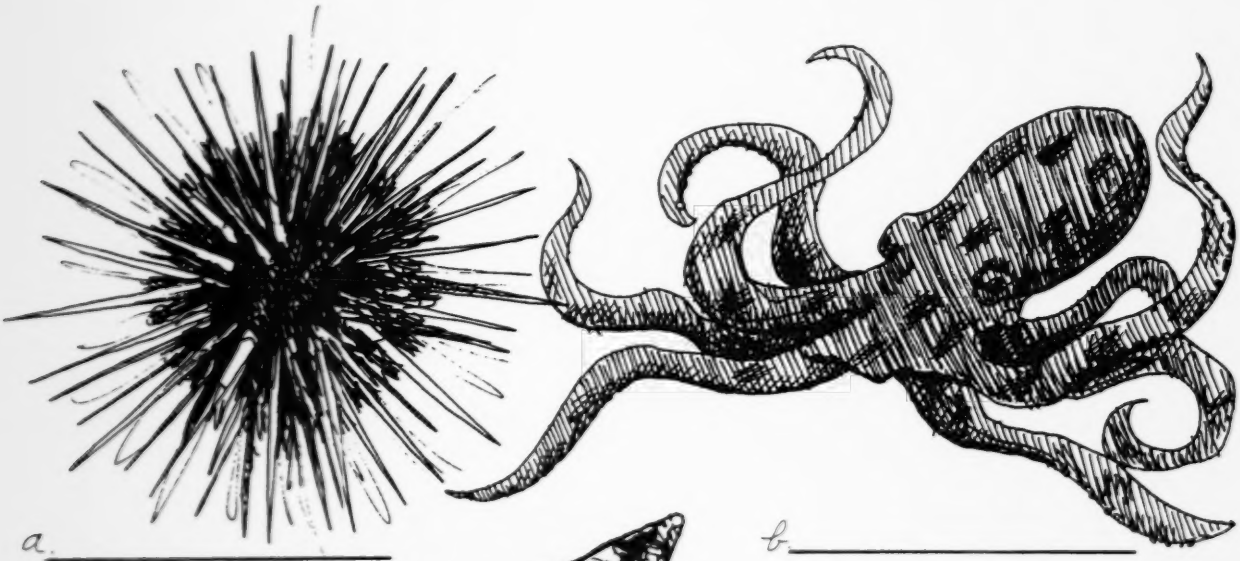
Poisonous cone shells are univalves found in the Indian and Pacific Oceans. They possess special teeth called radular teeth. With the radular teeth, cone shells are able to inflict a puncture wound and force venom (poison) into the wound. Paralysis, coma, and possible death are the effects on man.

The blue-spotted octopus is an inhabitant of the Indian and Pacific Oceans. It is also very poisonous to man. It can bite with its special beak and inject poison from its salivary glands. Bleeding may be severe. Vomiting, pain, difficulty in breathing and possible death can be the results.

Sea urchins belong to the same group of animals as the starfish, sea lily, and sand dollar. Some tropical species have hollow spines through which venom can be injected. Because the spines are brittle, they pose an additional problem as they often break off in the wound and are difficult to remove. Pain, paralysis, difficulty in breathing and sometimes death can be the result of a sea urchin sting.

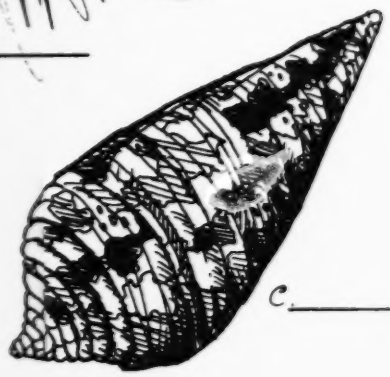
SEA STINGS

There is hidden danger in the sea! The world of underwater ocean animals is one of fierce competition for survival. In order to stay alive, many sea creatures have special devices for protection and food-gathering. Here are some sea animals with such devices. Can you match the animal drawing to its name, description, and the effect of its sting on man? Label each drawing from the descriptions given on the preceding page.



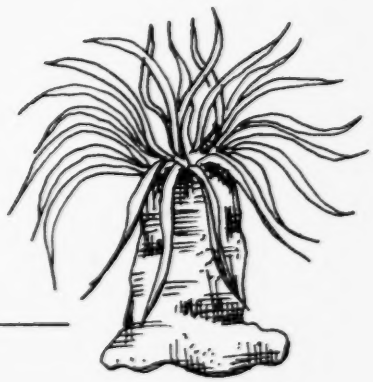
a. _____

b. _____



c. _____

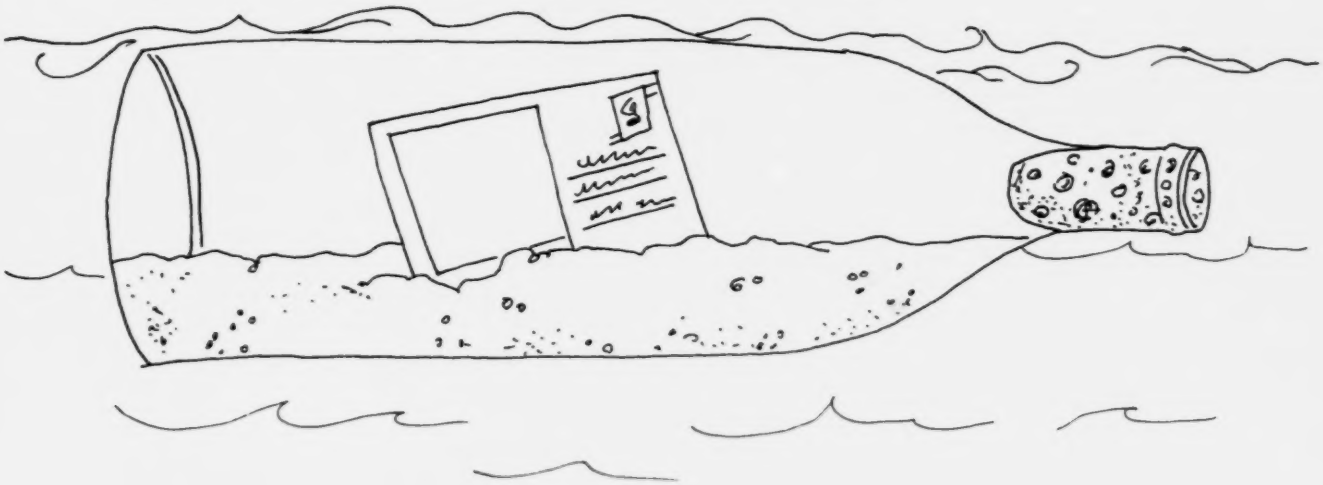
d. _____



e. _____

30

MAKE A DRIFT BOTTLE



A drift bottle is a weighted bottle which floats just below the surface of the water for the purpose of obtaining information about the direction and speed of ocean currents. Each year thousands of bottles are released into the ocean by oceanographers to aid them in charting the ocean currents. About 10 percent of them are returned. Many have crossed the Atlantic Ocean and have been found on the shores of England, Ireland, France and other places in Europe. At least one drift bottle has been known to travel halfway around the world. To make a drift bottle of your own, follow the instructions below.

MATERIALS: A clear soda bottle or similar type bottle with a tight-fitting cork. Clean, dry sand and a self-addressed postcard.

PROCEDURE: Add sand to the bottle until the bottle floats just below the surface of the water. On the self-addressed postcard, ask the finder to give information concerning the date and place where the bottle was found. Place the card in the bottle and cork tightly. If possible, have someone you know release the bottle into the ocean and give you the information concerning the date and place of the release. If this cannot be done, you may wish to release the bottle yourself into a nearby fast-moving stream or river. Good luck! You have a 10 percent chance of getting your postcard returned.

1. Sand was added to keep the bottle from floating on the surface of the water. Why?

2. Why was dry sand used?

3. Why are clear bottles better than colored bottles for this purpose?

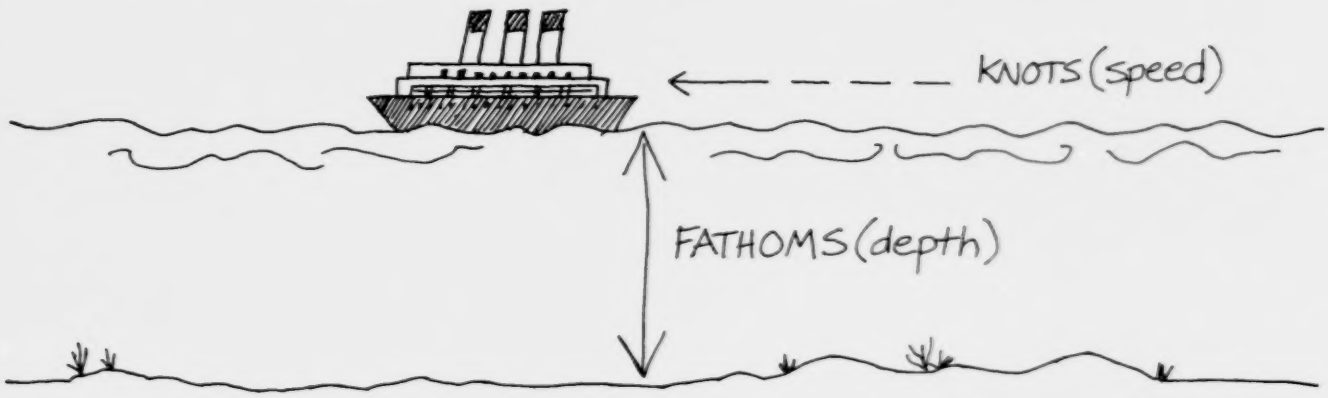
4. Explain how a bottle released off the coast of the United States can later be found on the coast of Ireland.

5. Do you think drift bottles are a good way of tracking ocean currents? Why?

6. If you found a drift bottle, would you return it?

MEASURING OCEAN DEPTHS AND SPEED

Ocean depth is measured in fathoms. A fathom equals six feet. Ships record their speed in knots per hour. A knot is the speed of one nautical mile, or 6076 feet, in an hour. On land we measure a mile to have 5280 feet. Using this information, solve the problems below.



1. How much greater is a nautical mile than an ordinary m ? _____

2. A ship traveling at ten knots per hour is traveling at what speed in feet per hour? _____

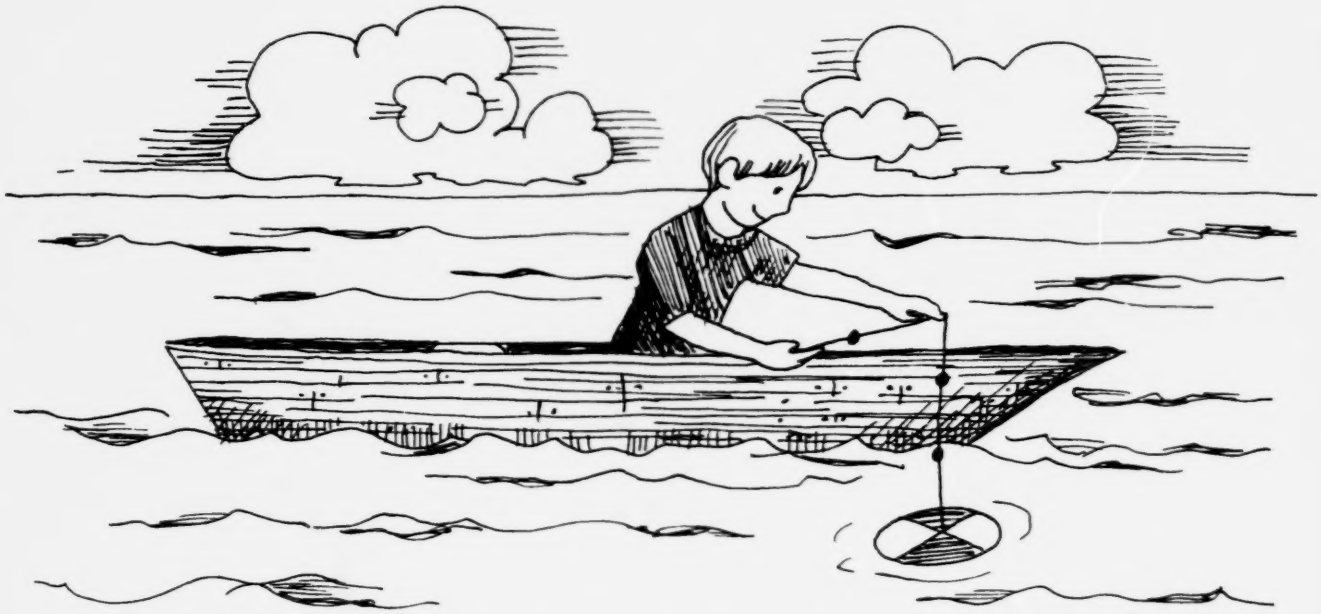
3. How many land miles per hour would this be? _____

4. A sunken ship buried at a depth of 49 fathoms is how many feet below the surface of the water? _____

5. Some whales are said to dive a half mile below the surface; if the statement is referring to land miles what would this be in fathoms? _____. If this statement is referring to nautical miles, what would this be in fathoms? _____

SECCHI DISC

A Secchi disc is an instrument used by oceanographers to measure the depth to which light can travel in ocean water. You can use a Secchi disc in a stream, a pond, or even a swimming pool.



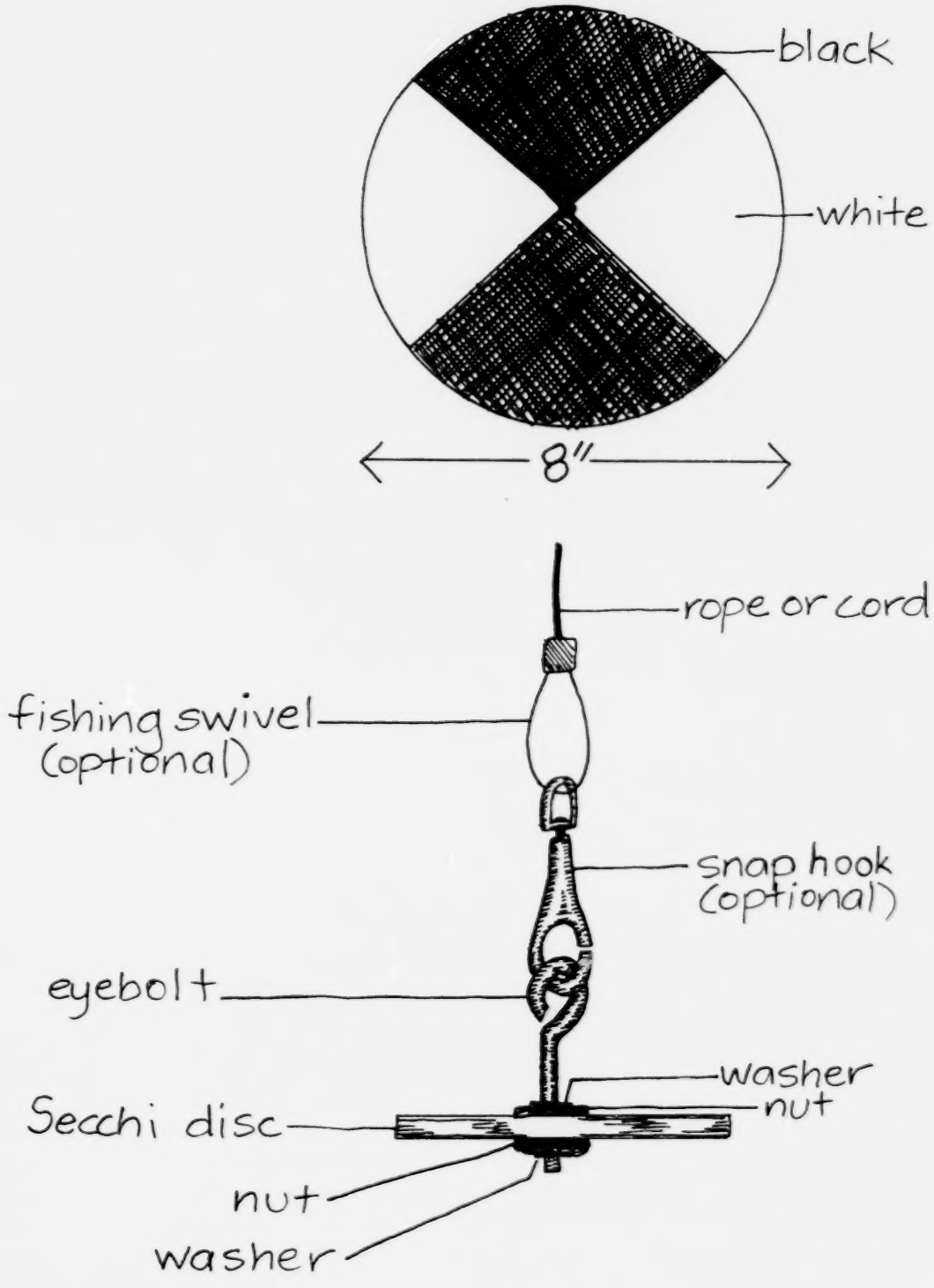
PURPOSE: To show how Secchi discs are made and used.

MATERIALS: A circle of galvanized metal* about eight inches in diameter, black and white enamel paint, brush, ruler, rope, eyebolt, two nuts, and two washers. Snap hook and fishing swivel are optional.

PROCEDURE: Divide the circle into quarters and paint the quarters alternately black and white. Make a hole in the center large enough to insert the eyebolt. Fasten the eyebolt with nuts and washers. In the rope make knots every foot.

*If marine plywood is substituted for the galvanized metal, a weight should be added.

Secchi Disc


black
white
8"
rope or cord
fishing swivel (optional)
snap hook (optional)
eyebolt
washer
nut
Secchi disc
nut
washer

To use the Secchi disc, lower it into the water slowly. Keep track of the number of feet of rope which go into the water. Stop when the disc disappears. Record the depth. Lower the disc a few more feet. Slowly raise it until it reappears. Record this depth by counting the number of feet you raised the disc until it reached the surface of the water. Add both readings and divide by two. This will give you the number of feet the light penetrated into the water you tested.

First reading _____ Water conditions:
Calm or rough _____
Second reading _____
Average _____ Weather conditions _____
Date _____

QUESTIONS:

1. Why would it be important for oceanographers to know the distance which light penetrates in ocean water?

2. What things are influenced by light in ocean water?

3. What conditions change the clearness of the water?

4. Do you think there are other ways of measuring the clearness of ocean water besides Secchi discs?

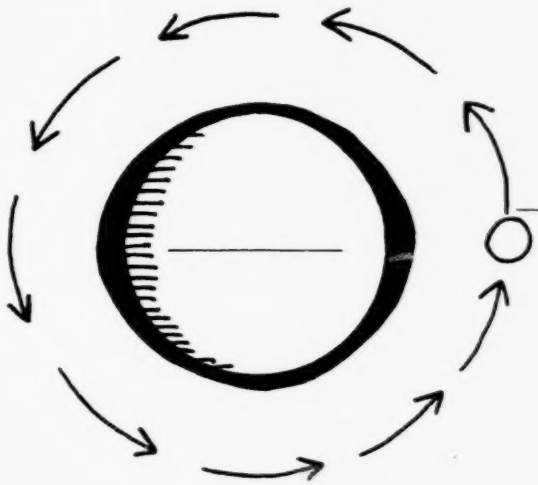
TIDES

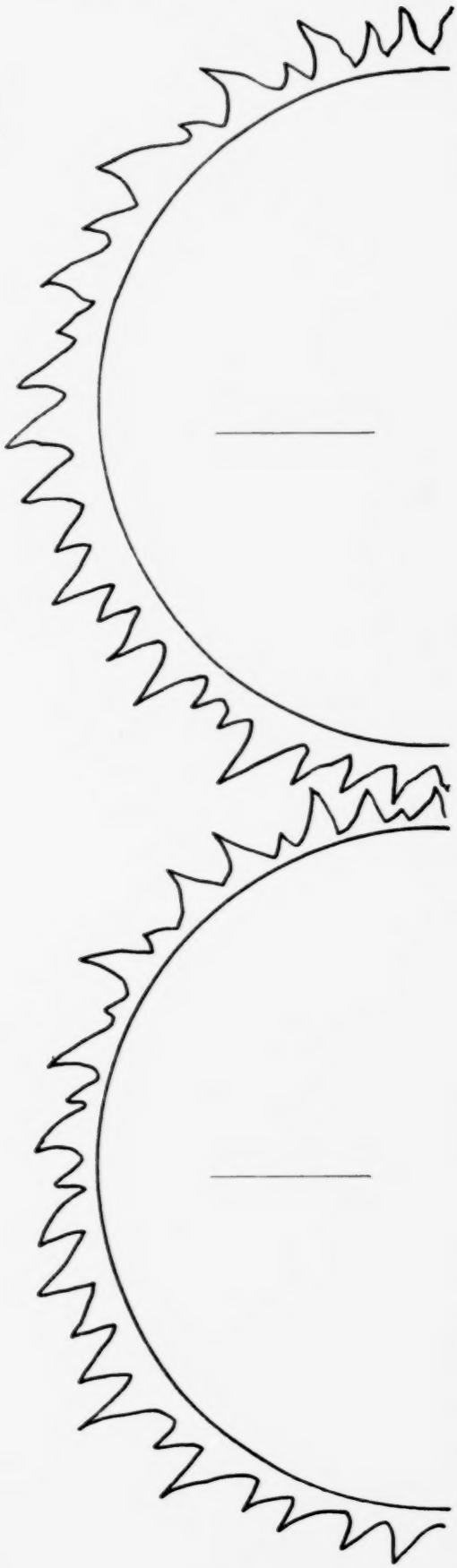
The rising and falling of the ocean's water is called the tide. The incoming tide at its crest is known as the high tide; the receding or outgoing tide is known as the low tide. Incoming water is called the flow and outgoing water is called the ebb.

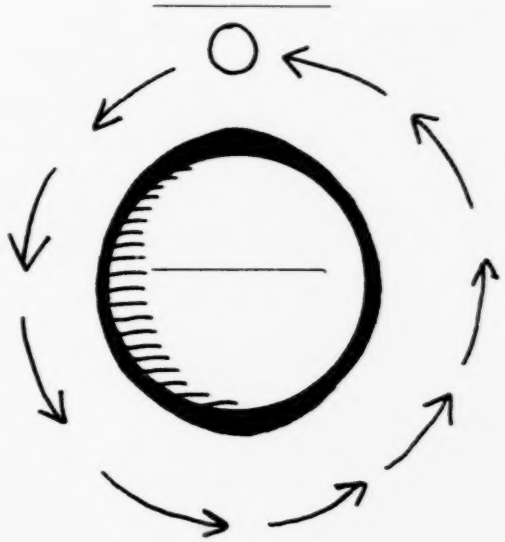
Tides are caused by the gravitational pull of the sun and the moon on the earth's oceans. The earth, of course, has a gravitational pull of its own; however, there is sufficient gravitational attraction of the moon and sun to draw ocean water away from the earth. The sun, although it is many times larger than the moon, has a lesser effect on the tides due to its greater distance from the earth. When the moon is farthest from the earth, abnormally low tides known as apogee tides take place. The highest tides occur when the sun and moon are in direct line with the earth, combining their gravitational pull in the same direction; these are called spring tides. (It should be noted the term has nothing to do with the spring season.) The opposite condition takes place when the earth, sun and the moon are at right angles to each other and the gravitational pulls of the sun and moon are acting against each other; at this time the lowest tides occur, known as neap tides.

Study the drawings on the following page, label the drawings and title spring tide or neap tide. Answer the questions on page 32.

TIDES (cont'd.): Label the sun, moon and earth on each drawing. Tell which drawing represents the spring tide and the neap tide.





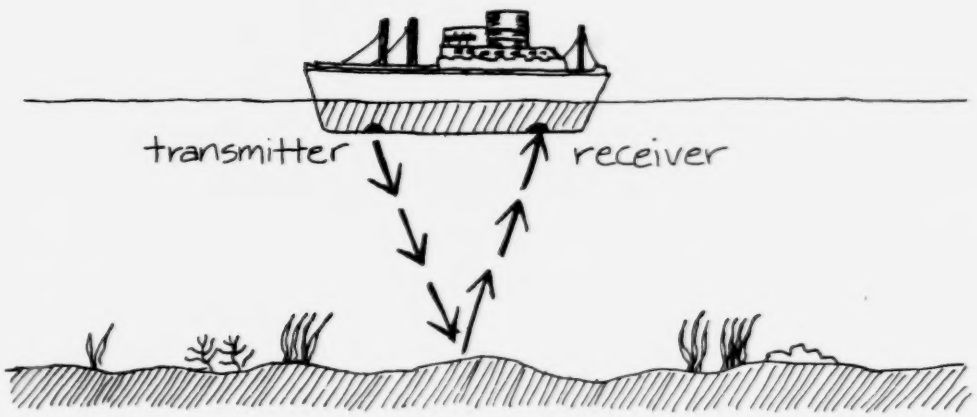


38

TIDES

1. The rising and falling of the ocean's waters is known as the _____.
2. The tide at its crest is called _____.
3. Receding tide is called _____.
4. Does the sun or the moon have a greater influence on the tides? _____
   Why? _____
   _____
5. What is a perigean tide? _____
   _____
6. What is the opposite of a perigean tide? _____
7. Why are spring tides the highest tides? _____
8. Do spring tides occur mostly in the spring? _____
9. What is the name for the incoming tidal water? _____
10. What is the name for the outgoing tidal water? _____
11. When do the lowest tides of all occur? _____
12. What are these low tides called? _____
13. Is it possible for a perigean tide to occur in addition to a spring tide? If so, what would the results be? _____
    _____
    _____

HOW OCEAN DEPTH IS MEASURED BY SOUNDING



Much of the ocean's topography has been mapped by the use of devices such as sounding. In this method sound is sent from a ship's transmitter to the ocean's bottom at an angle. It bounces back to the ship at the same angle and is picked up by a receiver on the same ship. We know that the speed of the sound is about 1524 meters per second (1524 m/s). By using this information and applying the following formula, ocean depth can be measured and mapped.

The formula for measuring ocean depth:

D = 1/2 T X V
D = depth
T = time
V = speed or velocity of sound in water (1534 meters per second)

Using this formula, find the depths of the ocean in the given locations and plot the depths on the graph to make a topographical map.

In a certain area of the ocean, a ship traveling in a straight line receives the following sonar signals:

Location a.	first signal	1 second
Location b.	second signal	2 seconds
Location c.	third signal	4 seconds
Location d.	fourth signal	8 seconds
Location e.	fifth signal	6 seconds
Location f.	sixth signal	4 seconds
Location g.	seventh signal	2 seconds
Location h.	eighth signal	2 seconds
Location i.	ninth signal	2 seconds
Location j.	tenth signal	1 second

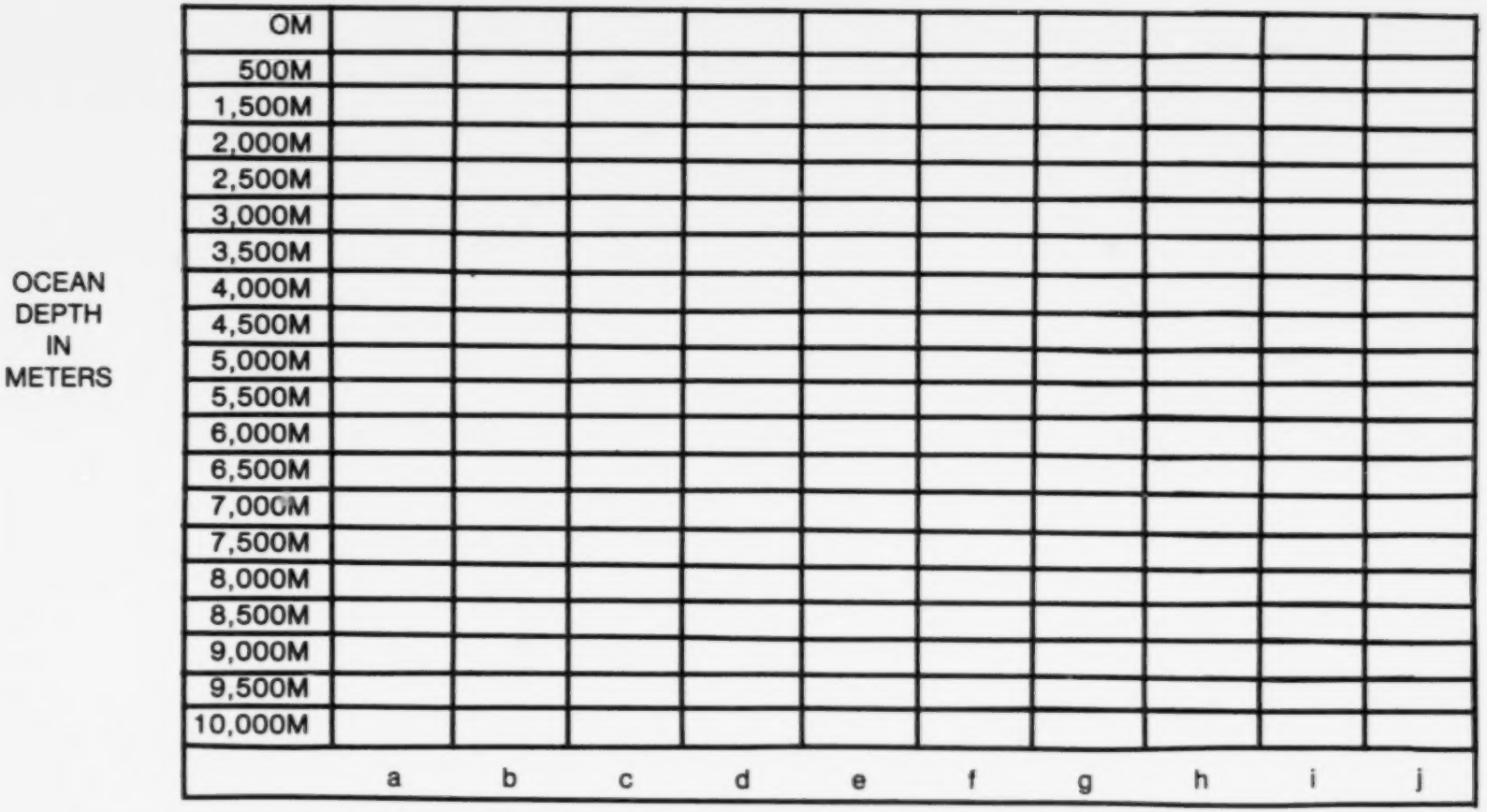
Find the depth in meters at each location.

Depth at a _____
Depth at b _____
Depth at c _____
Depth at d _____
Depth at e _____
Depth at f _____
Depth at g _____
Depth at h _____
Depth at i _____
Depth at j _____

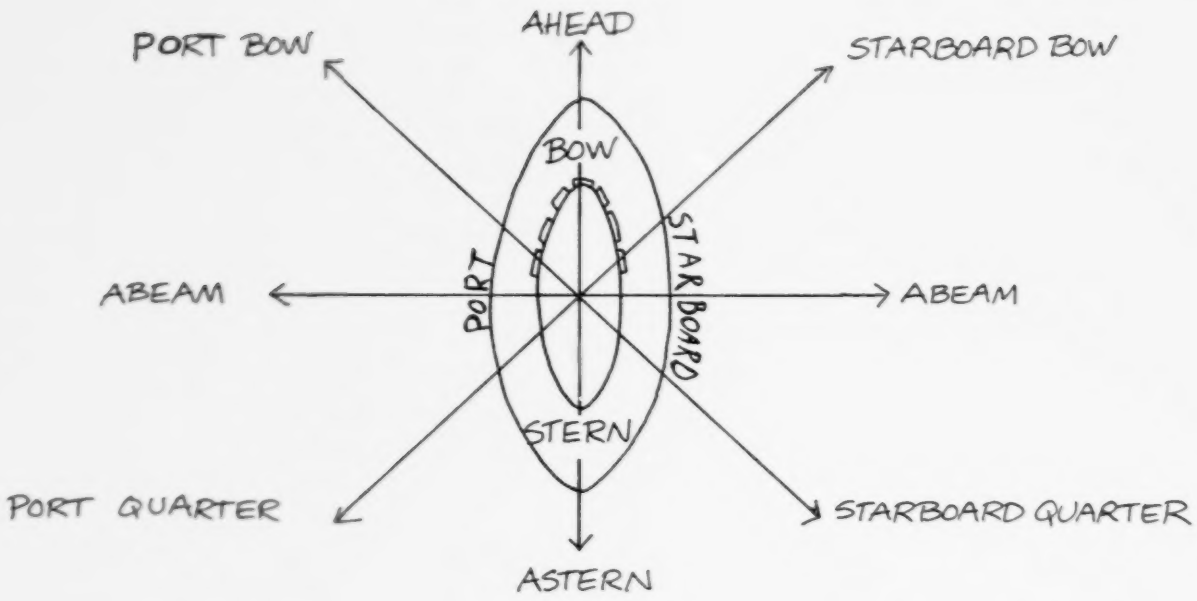
Using the graph on the following page, draw a map of this part of the ocean's floor (topography).

HOW OCEAN DEPTH IS MEASURED BY SOUNDING

GRAPH



NAUTICAL TERMS



1. The right side of a ship is called the _____.
2. The left side of a ship is called the _____.
3. The front end of a ship is known as the _____.
4. The part of a ship opposite the front is the _____.
5. An object sighted directly to the right-hand side of the ship would be said to be off the _____ _____.
6. An object floating in the water at the 10:30 clock position would be off the _____.
7. An iceberg directly in front of the ship would be straight _____.
8. A man overboard in the 6:00 o'clock position would be directly _____.
9. A buoy floating at the 4:30 position would be off the _____ _____.

THE UNSOLVED MYSTERY OF THE MARY CELESTE

One of the most unlucky ships of all times was the *Mary Celeste.* Only a few days after taking command, her first captain died. Later she collided with another ship, sinking it; and a few years later she ran aground off Nova Scotia. Her most unfortunate and mysterious voyage, however, occurred in November of 1872. It was then that she sailed from New York Harbor with a cargo of 1,700 barrels of commercial alcohol under the command of Captain Benjamin Briggs, who had his wife and two-year-old daughter aboard. There were also a mate, a second mate, four seamen, and a cook aboard. The ship was bound for Genoa. On November 25, she sailed past the island of Santa Maria in the Azores and Captain Briggs made a note of this. When the *Mary Celeste* was found nine days later, 350 miles east of the island of Santa Maria, no one was on the ship. The Captain, his family and crew were never seen nor heard from again. It was as if they had disappeared from the face of the earth. On board was plenty of food and water. There were no signs of violence and only very minor damage had been done to the ship. No satisfactory explanation to the mystery of the *Mary Celeste* has ever been found.

Seventeen times in the next thirteen years she was sold, going from one owner to another; the *Mary Celeste* was never able to make a profit. Her last owner deliberately ran the ship into a reef, finally making the unlucky *Mary Celeste* a total loss and ending the jinx forever.

Write a paragraph of your own on what you think may have happened to the *Mary Celeste.*

ICEBERGS

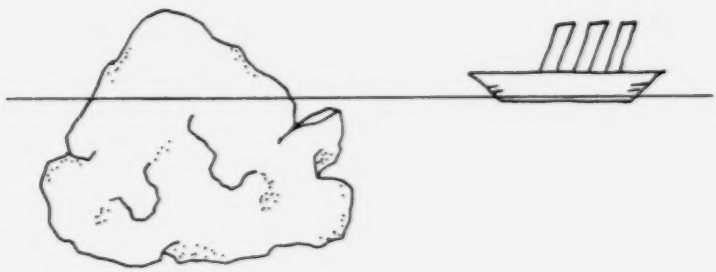
Icebergs are massive chunks of ice which break away from glaciers and fall into the sea. An iceberg may weigh as much as a million tons and can be several miles long. The icebergs of fresh water which float in the North Atlantic Ocean were formed in Greenland. With great noise they break off in huge ice sheets and drift southward until they melt some 400 miles south of Newfoundland. Due to their enormous size and the fact that ninety percent of icebergs are below the surface of the sea, they have caused many sea tragedies.

Icebergs carry with them debris such as boulders and gravel which fall into the sea as the icebergs melt.

PURPOSE: To show how icebergs are formed, the way in which they float and their potential danger to ships.

MATERIALS: Heavy plastic bag, seawater,* fresh water, small amount of fine gravel, large container (such as an aquarium), toy boat if desired.

PROCEDURE: In a heavy plastic bag, freeze some fresh water and a little fine gravel. When solidly frozen, remove from bag and allow to thaw in a large container of salt water.



1. How much of the iceberg is above water? _____
2. How long did it take the iceberg to melt? _____
3. Where do icebergs pick up the gravel and stones which they carry? _____
   _____
   _____
4. What is the name of huge masses of ice that are located on land? _____
   _____
5. Where are the icebergs which float in the North Atlantic Ocean formed? _____

*To make seawater, dissolve 35 grams of salt to each 965 grams of water.

A SHIP OF CONTRADICTIONS

This ship was considered "unsinkable"...but it sank.

This ship was warned several times of heavy icebergs sighted nearby...but the warnings were not taken seriously.

This ship had lifeboats for 1178 people...but there were 2207 passengers on board.

Multimillionaires on this ship left large amounts of money, priceless jewels, stocks and bonds, and other valuables and treasures in their cabins...but they took oranges and warm clothing with them.

This ship sent wireless messages to a nearby liner, the *Californian*...but the radio operator on the *Californian* had gone to bed ten minutes earlier.

This ship sent up rockets and flares seeking help from the *Californian*...but they were disregarded, although seen.

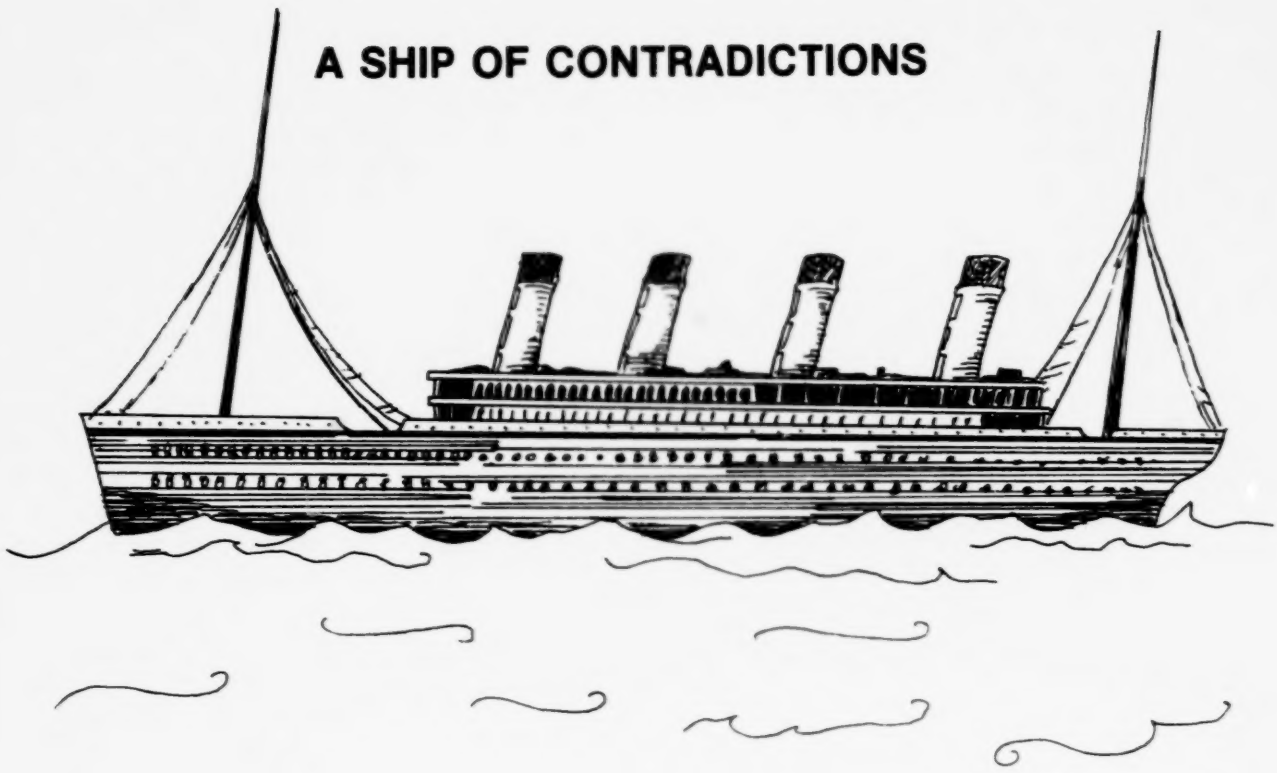
Many lifeboats on this ship were lowered half empty...but later the same half-empty lifeboats would not return for swimmers thrashing in bitter cold water for fear of upsetting or overloading their boats.

Some women refused to go into the lifeboats...but some men disguised themselves as women in order to get into the lifeboats.

One leading New York newspaper reported that all on this ship were saved and that it was being towed into port...but another reported it had sunk.

This ship was built to last decades...but it did not complete its first Atlantic crossing.

A SHIP OF CONTRADICTIONS



Questions for discussion:

1. Do you know the name of this ship? If so, what is it?

   _____

2. Do you know of any rules, agencies, governmental or safety regulations which, if they had been established at the time, could have prevented or lessened this tragedy?

   _____

   _____

   _____

   _____

3. Is it possible for such a tragedy to happen again? Why or why not? _____

   _____

THE TITANIC'S MESSAGE IN RADIO CODE

The Morse code (radio code) has two symbols, a dot and a dash. The messages sent by the *Titanic* were wireless messages sent in Morse code. Below is a copy of this code and on the next page is the message the *Titanic* sent out at 11:50 p.m. on April 14, 1912, shortly before it sank. Use the sample code to decipher the *Titanic's* message.

MORSE CODE

.- A	.--- J	... S
-... B	-.- K	- T
-.-. C	.-.. L	..- U
-.. D	-- M	...- V
. E	-. N	.-- W
..-. F	--- O	-..- X
--. G	.--. P	-.-- Y
.... H	--.- Q	--.. Z
.. I	.-. R	

When sending messages in Morse code, a pause indicates the end of a word. In writing use a slash (/) to indicate the end of a word.

Decipher the *Titanic's* message given below.

.-- ./ .... .- ...- ./ ... - .-. ..- -.-. -.-/ .. -.-. . -... . .-. --./ ... .. -. -.- .. -. --./ ..-. .- ... -/ -.-. ---.--./ - ---/ --- ..- .-./ .- ... ... - .- -. -.-. ./

In the space below, try writing some Morse code messages of your own.

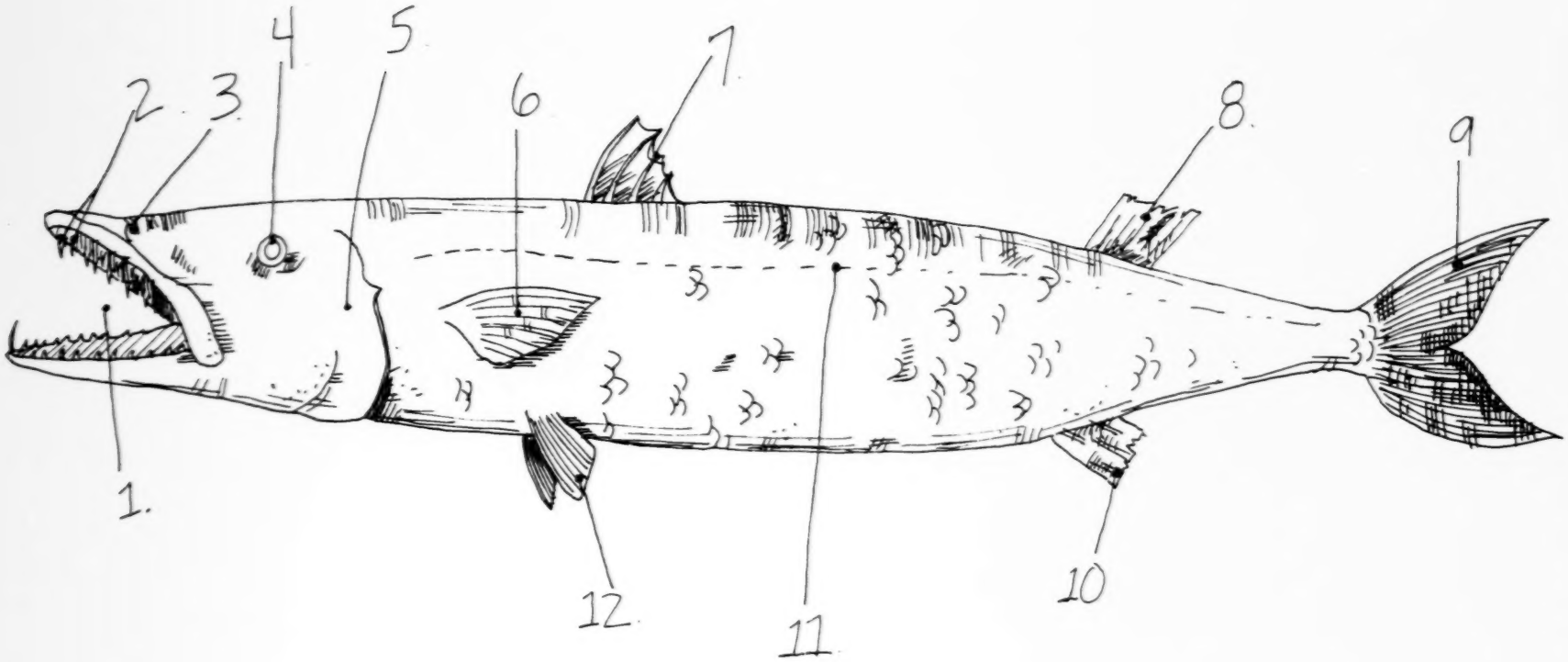
BARRACUDA EXTERNAL

Barracuda are mean-tempered, ferocious fish which will attack almost any moving object; this habit has given them the name "tigers of the sea." They have long slender bodies and may attain a length of eight feet and weigh as much as forty pounds. Their jaws are equipped with razor-sharp teeth which are replaced as they are lost. Several different species are generally found in tropical waters, most notable of which are the Great Barracuda, a large type that inhabits the waters surrounding the West Indies; the California Barracuda, a smaller and more tasty variety; and, in other parts of the world, the European and Australian Barracuda.

Use the terms below to complete the matching statements describing the external features of a barracuda and to label the drawing on the next page.

teeth	lateral line	second dorsal fin	anal fin
nostril	pelvic fin	first dorsal fin	pectoral fin
eye	mouth	gill cover	caudal fin

1. _____ is the opening to the digestive system.
2. _____ are sharp and razor like for tearing prey.
3. _____ is an organ of smell.
4. _____ is an organ of sight.
5. _____ protects the delicate gills.
6. _____ is the first pair of fins located near the heart.
7. _____ is the first fin on a fish's back.
8. _____ is the second fin on a fish's back.
9. _____ is the tail fin.
10. _____ is the fin located at the end of the digestive tract.
11. _____ is a line of sensory cells located along the sides of a fish's body.
12. _____ are paired fins located in back of and below the pectoral fins.



Barracuda - External

51

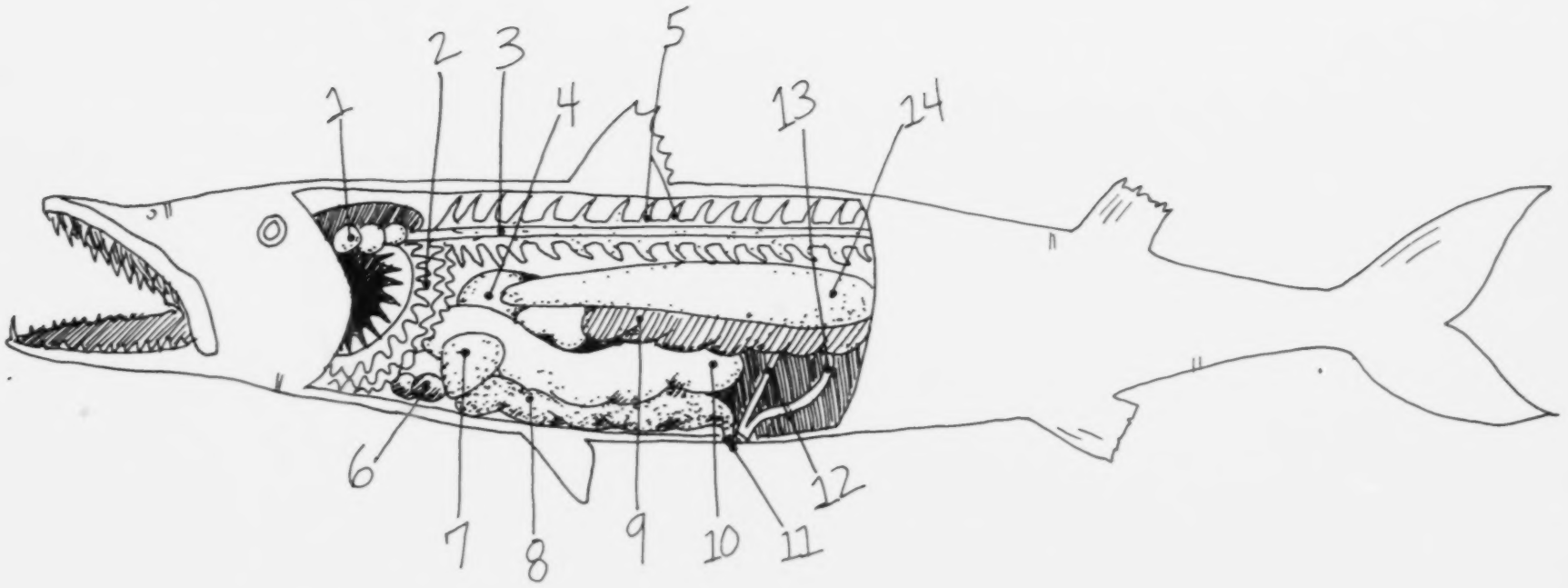
52

BARRACUDA INTERNAL

The shape of a barracuda's body is long and slender; this allows for great speed and agility in swimming and attacking its prey. The internal organs of a barracuda's body conform to its streamlined shape. Internally, most fish are equipped with small *brains*, a *dorsal nerve cord* protected by *vertebrae*, *gill* for extracting oxygen from the water, a two-chambered *heart* which pumps red blood in a closed circulatory system, a *kidney* for excreting liquid wastes, a *liver* located behind the heart, a large *stomach* followed by a coiled *intestine*, a *reproductive organ* lying above and to the rear of the stomach, and a large *swim bladder* which lies near the dorsal wall.The *reproductive duct* joins the *kidney duct* at the rear of the *anus*.

Use the italicized terms in the paragraph above to complete the statements below and to label the drawing of the internal organs of the barracuda on the next page.

1. _____ is the center of the nervous system.
2. _____ is an organ of respiration in fish.
3. _____ is a large nerve running along the back wall of a fish.
4. _____ is an organ which removes nitrogen wastes from the blood.
5. _____ form the spinal column of a fish.
6. _____ pumps blood throughout the fish's body.
7. _____ filters blood, secretes bile, stores food, and gets rid of wastes.
8. _____ is a coiled tube which leads from the stomach to the anus.
9. _____ produces either eggs or sperm.
10. _____ is an organ of digestion which secretes gastric juices.
11. _____ is the place where undigested food and solid wastes are excreted.
12. _____ is a narrow tube through which either eggs or sperms will pass.
13. _____ is a narrow tube through which liquid wastes leave the body.
14. _____ keeps fish from sinking and regulates depth equilibrium.

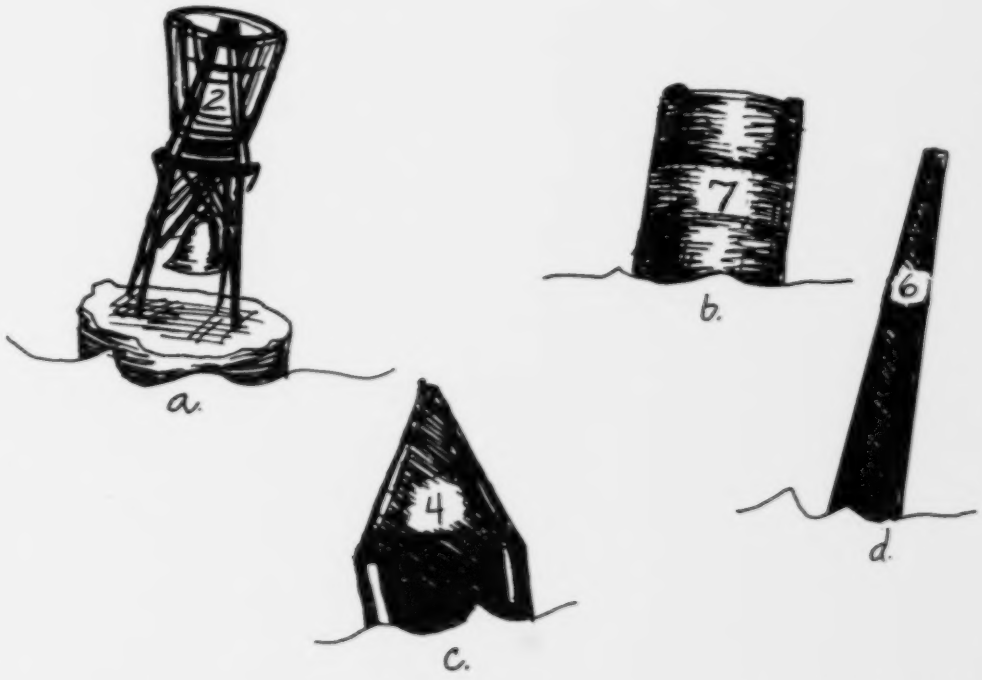


45

Barracuda-Internal

BUOYS

A buoy is a floating device which is anchored in the water. Buoys warn of rocks or shoals or mark a channel. Some buoys have bells, whistles or lights. Buoys are numbered and painted black or red. Even numbered or red buoys direct ships to the right; odd numbered or black buoys direct ships to the left.



Above are four types of buoys. By their shapes can you identify the following buoys?

1. _____ spar buoy
2. _____ can buoy
3. _____ nun buoy
4. _____ bell buoy

Which buoy(s) directs sailors to go to the right? _____

Which buoy(s) directs sailors to go to the left? _____

SAILORS' JARGON

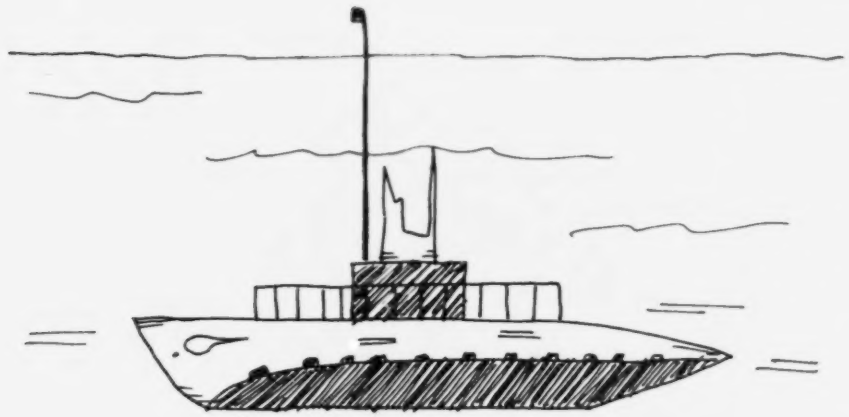
Jargon is the use of words or phrases used by a special group of people. "Grand slam" is an example of baseball jargon. After a period of time, jargon may become part of the language. Below are some examples of sailors' jargon.

"Booby hatch"
"Boondocks"
"Davey Jones' locker"
"Limey"
"Grog"
"Landlubber"
"Mess"
"Three sheets in the wind"
"When my ship comes in"
"Take down a peg"
"Brass"
"Thar she blows"
"Scuttlebutt"
"Log"
"High seas"

Complete the following sentences by using the examples of jargon:

1. _____ means very drunk; refers to a sailing ship beyond control.
2. _____ tells that a whale has been sighted.
3. _____ pertains to a dining hall or food.
4. _____ means back-country area.
5. _____ refers to an insane asylum as deranged sailors in the old days were confined to an area with a hatch.
6. _____ is alcoholic spirits, usually rum.
7. _____ means top-ranking officers; refers to the gold braid on officers' uniforms.
8. _____ means gossip, originally referring to the cask from which sailors drank water and gathered around to exchange rumors.
9. _____ are the open oceans.
10. _____ is a record of traveling; originally the way a ship kept track of its speed on a log.
11. _____ means to reduce in honor; originates from the days when ships' flags were raised or lowered on a system of pegs.
12. _____ is where the dead or the drowned go.
13. _____ says "when I am rich."
14. _____ refers to a British sailor who was so-called when sailors ate limes in order to prevent scurvy.
15. _____ is a person on a ship who wishes to be on land.

MAKE A SIMPLE PERISCOPE



A necessary instrument for submarines is the periscope which allows the crew to see above the water level. The word periscope comes from two Greek words, "scope" to look, and "peri" around.

Periscopes can be very complicated instruments. On some submarines they can be raised as high as forty feet and rotate 360 degrees. Other periscopes are really telescopes which sight objects at great distances. Some periscopes have cameras attached.

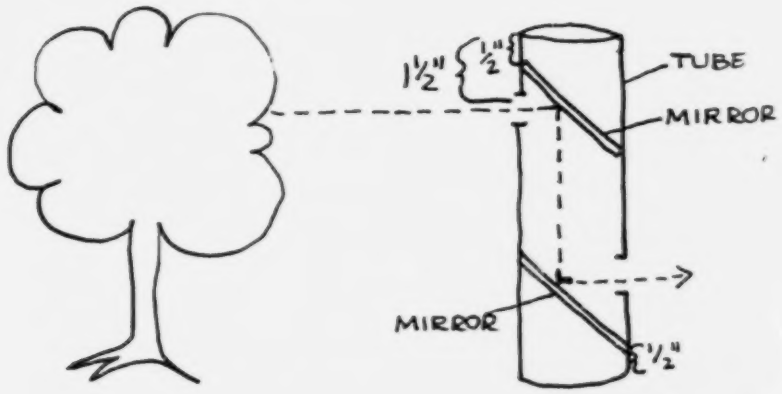
A periscope of your own can be a valuable tool which will aid you in looking around corners or above high fences and walls. It does this by the use of two mirrors. The image is reflected from the first mirror to the second mirror to the eye. If you follow the instructions on the next page, you can make a simple periscope of your own.

PURPOSE: To understand the principles on which periscopes are made; to appreciate the advantages of using periscopes.

MATERIALS: A tube such as a mailing tube, or two one-quart milk cartons, or a constructed box or tube in which to house the periscope; two mirrors which fit the tube, tape, a cutting tool such as a knife or razor blade.

PROCEDURE: Cut 2 windows on opposite sides about 1½ inches from the ends of the tube. Tape the mirrors at 45 degree angles in tube about ½ inch from the ends. Mirrors should be facing each other. If you used one-quart milk cartons, begin by cutting the tops off the cartons and making the tube by inserting the open end of one carton into the open end of the other.

Your periscope will look like this:



QUESTIONS ON PERISCOPES

1. Would it be possible for modern submarines to function as they do without the invention of periscopes? Why or why not?

2. From what two words does the word "periscope" come?

3. Most periscopes are really combinations of periscopes and telescopes. Why?

4. How might periscopes be of value in places where radioactive materials are being used?

5. Periscopes have many uses in modern medicine. One is in the instrument called a gastroscope. What is the purpose of a gastroscope?

6. What other words do you know which have the root word "scope" in them?

7. Tell or write how types of periscopes can be valuable in the following situations:

   a. A soldier in a trench

   b. A patient with bronchial disease (Bronchi are the tubes which lead to the lungs.)

   c. A spectator in a crowd

ENDANGERED SPECIES OF THE SEA

Each of the animals below is associated with the sea. Each is also endangered. An endangered animal is one whose numbers have been reduced to the point that these animals may become extinct; that is, they will never again be seen alive on the face of the earth. Can you match the animal to some of the possible reasons for its endangered classification?

brown pelican	blue whale	manatee	Atlantic salmon
sea otter	green turtle	polar bear	bowhead whale

1. _____ The main reason this four-foot, 500-pound reptile is endangered is that both its flesh and eggs are considered gourmet foods.

2. _____ The largest animal that ever lived is decreasing in numbers. Although protected by the International Commission it remains extremely scarce. Greed and profit caused this animal to be killed in large numbers to obtain the products made from its huge body.

3. _____ This gentle animal is really a sea cow which eats vegetation in channels and riverbeds. Pollution, thoughtless shooting, and boat propellers have brought it to the brink of extinction.

4. _____ The shells of this bird's eggs, weakened from the effects of DDT, are not strong enough to protect the young embryo inside. Ban on the use of DDT products has helped to reverse this condition.

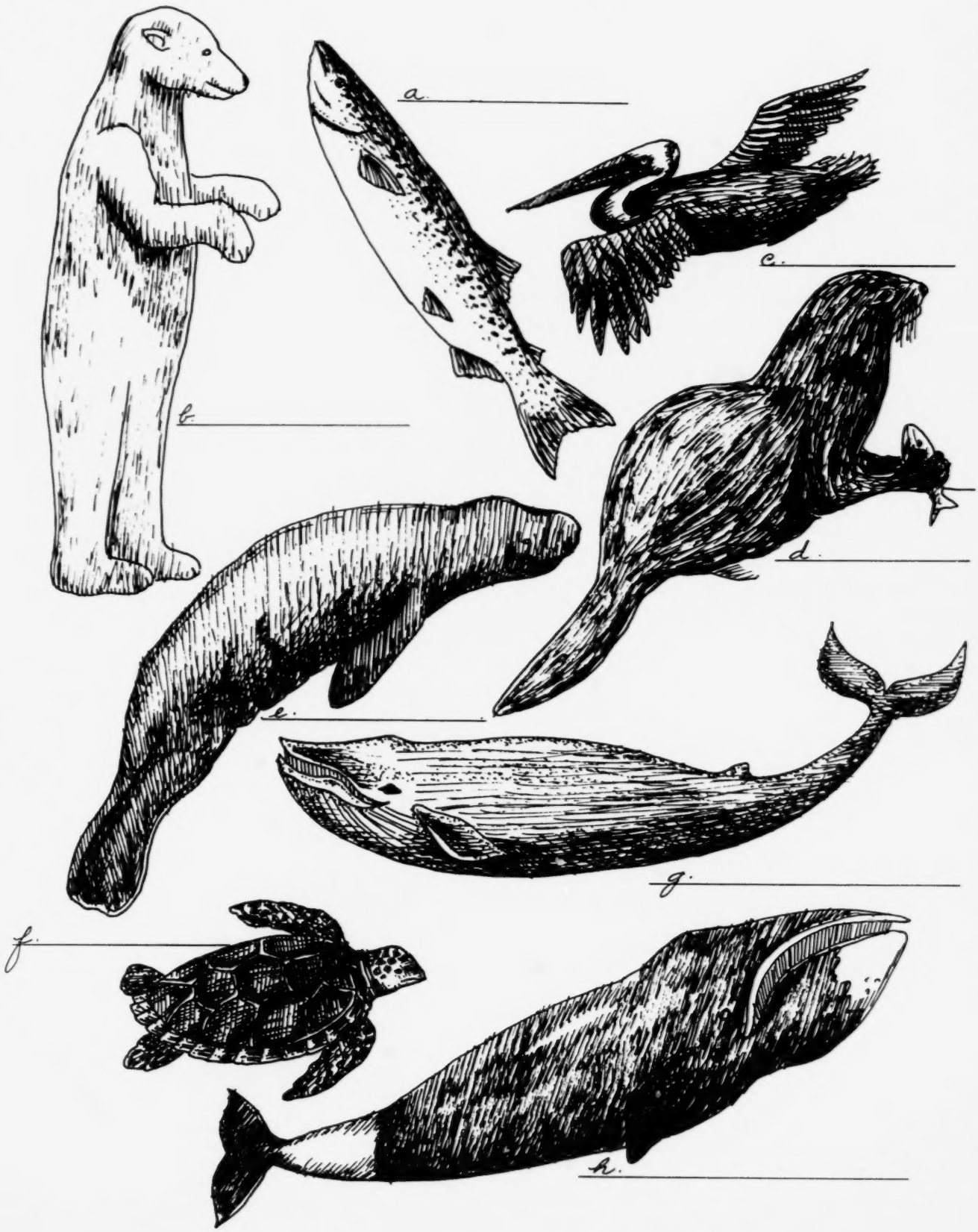
5. _____ The fur of this mammal is so very valuable that in California it was nearly wiped out by trappers. It is now doing well in the Aleutian Islands where it lives in refuges.

6. _____ These fish are hatched in fresh water but, as their parents did before them, leave fresh water for the Atlantic Ocean. After maturing they return to the river of their birth to spawn and repeat the cycle. Pollution and overfishing are steadily decreasing their numbers.

7. _____ Traveling long distances by land and sea, this mammal blends well with its Arctic surroundings. Hunters and trophy seekers have driven it to the brink of extinction, and it is estimated there are only 10,000 left in the entire world.

8. _____ The immense aquatic mammal is recognized by its black coloration with contrasting white chin. It was hunted by harpoons in cold waters where it once existed in great numbers. Although it is now protected, it is rarely seen.

On the next page are drawings of the animals described above and on the previous page; use them to help you choose your answers. Label each animal with its correct name. You may wish to do a special report on one or more of these endangered species of the sea.



62

CAREERS IN OCEANOGRAPHY

If you like the ocean and would enjoy working on, in, or near the sea, you may wish to consider a career in oceanography. Here are a few:

Biological Oceanographer

Biological oceanographers are often called marine biologists; they study the plants and animals which inhabit the ocean and its shores. A few marine biologists specialize in bacteria; others concentrate their efforts on plants and animals. Marine biologists often narrow their work down to a particular group of plants or animals such as whales. Because of the ocean's possibilities as a food source, many marine biologists study ways of growing and obtaining food from the sea.

Geological Oceanographer

Geological oceanographers study the ocean floor, its composition and physical features (topography). With the use of specialized equipment they search for mineral and oil deposits and take core samples of the ocean's bottom in order to find ways to collect and extract these riches from the sea. By means of echo soundings and sonar devices,they map the ocean's floor.

Chemical Oceanographer

Chemical oceanographers test and study the composition of the sea. They test for the elements found in the seawater such as chlorine, sulfur, bromine, flourine, magnesium, calcium, and others. The many elements found in seawater make it a most complex chemical soup. Some of these elements would have great value if ways to remove them from seawater could be made easier and cheaper. This is a challenge for the chemical oceanographer.

Physical Oceanographer

Physical oceanographers are concerned with the physical properties of the ocean such as the tides, waves, currents, density and salinity (saltiness) of the sea. They also measure the ways light and sound travel in the ocean. Physical oceanographers study and map the ocean's floor and chart currents. A knowledge of math and physics are necessary in this field of oceanography.

64

After reading **CAREERS IN OCEANOGRAPHY** can you answer which oceanographer most likely would do the following:

a. Study and chart the tides? _____
b. Attempt to extract (take) gold from seawater? _____
c. Look for undersea oil? _____
d. Determine the depth of sunlight? _____
e. Study the migration of whales? _____
f. Find ways of increasing the oyster population? _____
g. Chart an ocean current? _____
h. Examine the salt content of seawater? _____
i. Measure the ocean's depth? _____
j. Trace the life cycle of an eel? _____

Determine which oceanographer would be most likely to use the following pieces of equipment:

1. _____ drift bottle
2. _____ plankton net
3. _____ Secchi disc
4. _____ reversing thermometers
5. _____ corer
6. _____ sonar
7. _____ current meter
8. _____ grab sampler

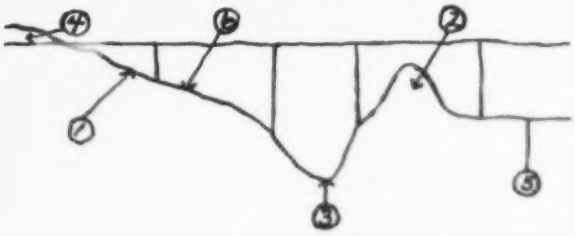
_____
Date

_____ is awarded this certificate for "diving into" oceanography.

_____
Captain

ANSWER KEY

Page 1: The Topography of the Sea



Pages 2-3: In Which Ocean Is the Ship Sailing?

a. Pacific	f. Indian	k. Atlantic
b. Pacific	g. Pacific	l. Atlantic
c. Indian	h. Arctic	m. Arctic
d. Atlantic	i. Pacific	n. Arctic
e. Atlantic	j. Indian	o. Pacific

Page 5: Ocean Currents

1.	f.	Gulf Stream
2.	e.	Humbolt (Peru)
3.	i.	Kuroshio (Japan)
4.	h.	West Wind Drift
5.	b.	North Equatorial Current
6.	d.	South Equatorial Current
7.	c.	Equatorial Counter Current
8.	g.	Brazilian Current
9.	a.	California Current
10.	j.	Benguela
11.	k.	Agulhas
12.	l.	Labrador

Page 7: Latitude and Longitude

Allow for variations of a degree or two in the answers to compensate for the drawings which are, of course, out of scale.

1.	Hot air balloon	Lat. 21° N.	Long. 171° E.
2.	Parachute	Lat. 15° N.	Long. 163° W.
3.	Rowboat	Lat. 18° S.	Long. 118° W.
4.	Lifesaver	Lat. 9° N.	Long. 179° W.
5.	Island	Lat. 12° S.	Long. 170° E.
6.	Airplane	Lat. 6° N.	Long. 172° E.
7.	Blimp	Lat. 10° S.	Long. 165° W.

Page 7:

8.	Sailboat	Lat. 3° S.	Long 179° E.
9.	Buoy	Lat. 23° N.	Long. 155° W.
10.	Life raft	Lat. 22° S.	Long. 177° W.
11.	Ocean liner	Lat. 4° N.	Long. 159° W.

Questions

1. 0° longitude
2. 0° latitude
3. International Date Line
4. latitude
5. longitude
6. North Pole

Page 9: Prefixes Used in Oceanography

The prefixes in order are:

hydro-sphere	in-vertebrates
phyto-plankton	uni-valves
chloro-phyll	bi-valves
photo-synthesis	aqua-nauts
zoo-plankton	sub-marines

Page 11: Float an Egg in Salt Water.

1. The egg will float in salt water.
2. 7 × 35 grams = 245 grams per liter

Page 12: Salt from Seawater

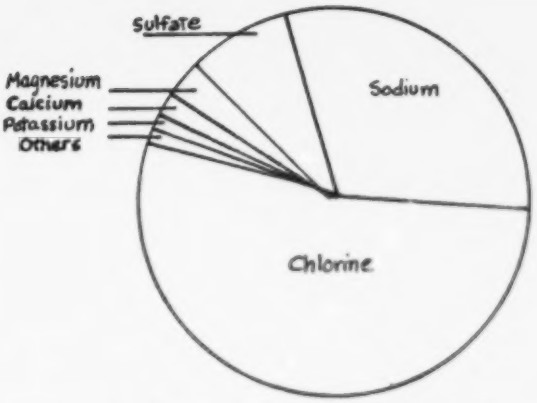
1. 35 grams of salt to 965 grams of water
2. Answers will vary.
3. Condensation of the steam into fresh water

Page 14: What Keeps the Oceans from Freezing?

1 to 4. Answers will vary.

5. Salt water in test tube A
6. Answers will vary.
7. No.
8. Currents, movement of the water, amount of salt, wind, etc.
9. Yes.
10. Near the mouths of rivers, etc., where fresh water is mixed with salt water.
11. Yes.
12. We have evidence of this happening during the ice ages.

Page 15: Ions in Seawater



Page 16: A Test for the Chloride Ion

In the chemical reaction the solution turns milky from the addition of silver nitrate if the chloride ion is present.

Page 18: Wave Problems

1. 20 ÷ 40 = .5 waves per second
2. 60 ÷ 20 = 3 seconds
3. 45 ÷ 15 = 3 waves per second
4. 60 ÷ 50 = 1.2 seconds

Page 19: Does Water Bend Light?

Conclusion: Water bends the light and distorts the figure of the diver.

Page 21: How Does Depth Affect Pressure?

1. The greater the depth, the greater the pressure
2. The lowest hole on the can -- greatest pressure
3. The highest hole--least pressure
4. The second hole in can A and the three holes in can B--similar depth
5. The water pressure in the oceans is greatest at the deepest parts.

Page 23: Sea Stings

a. sea urchin
b. blue-spotted octopus
c. cone shell
d. Portuguese man-of-war
e. sea anemone

Page 25: Make a Drift Bottle

1. You are attempting to track water currents and do not want the wind to influence the speed or direction of the bottle.
2. The sand won't damage the postcard and will shift as the bottle moves.
3. They are more easily seen.
4. Most likely it was carried by the Gulf Stream Current.
5. Yes, they are fairly accurate and very inexpensive.
6. Hopefully, all will answer "yes."

Page 26: Measuring Ocean Depth and Speed

1. 796 feet
2. 60,760 feet per hour
3. 11.5 miles per hour
4. 294 feet
5. 440 fathoms; 506.3 fathoms

Page 29: Secchi Disc

1. The amount of light controls the plant and animal populations; it is also very important to divers.
2. Green plants cannot live without light.
3. Currents, upwelling, nearness to land, wind, pollution, etc.
4. Yes, there are more modern methods.

Page 31: Tides

The top picture is the spring tide.
The bottom picture is the neap tide.

Page 32: Tides

1. tides
2. high tide
3. low tide
4. moon (It is closer.)
5. Perigee tide is a higher than usual high tide caused by the nearness of the moon in its orbit.
6. Apogee
7. The sun and moon are in direct line and pulling together.
8. No.

Page 32: (cont'd.)

9. flow
10. ebb
11. Lowest tides occur when the sun, earth, and moon are at right angles to each other.
12. neap
13. Yes. The tides would be exceptionally high.

Page 34: How Ocean Depth Is Measured by Sounding

Depth at:

a.	767m.	f.	3068m.
b.	1534m.	g.	1534m.
c.	3068m.	h.	1534m.
d.	6136m.	i.	1534m.
e.	4602m.	j.	767m.

Page 36: Nautical Terms

1. starboard
2. port
3. bow
4. stern
5. starboard beam (abeam)
6. port bow
7. ahead
8. astern
9. starboard quarter

Page 38: Icebergs

1. 10 to 20%; answers will vary.
2. Answers will vary.
3. The gravel and stones were picked up as the icebergs were formed on land.
4. Glaciers
5. Greenland

Page 40: A Ship of Contradictions

1. The *Titanic*, which sank at 11:40 p.m. Sunday, April 14, 1912. Many consider it to be the worst sea disaster of all time. About 1500 lives were lost.
2. The International Ice Patrol was established by the American and British governments as a result of the *Titanic*. Icebergs are now tracked and winter lanes are rerouted further south. Ocean liners must now carry sufficient lifeboats for all passengers, and have radio operators on duty 24 hours a day.
3. Answers will vary.

Page 41: The *Titanic's* Message in Radio Code:

We have struck iceberg Sinking fast Come to our assistance

Pages 42-43 (Answers to both pages are the same.): Barracuda External

1. mouth
2. teeth
3. nostril
4. eye
5. gill cover (operculum)
6. pectoral fin
7. 1st dorsal fin
8. 2nd dorsal fin
9. caudal fin
10. anal fin
11. lateral line
12. pelvic fin

Pages 44-45 (Answers to both pages are the same.): Barracuda Internal

1. brain
2. gill
3. dorsal nerve cord
4. kidney
5. vertebrae
6. heart
7. liver
8. intestine
9. reproductive organ or gonad
10. stomach
11. anus
12. reproductive duct
13. kidney duct
14. swim bladder

Page 46: Buoys

1. d
2. b
3. c
4. a

The buoys which direct to the right are a, c, and d.

The buoy which directs to the left is b.

Page 47: Sailors' Jargon

1. "Three sheets to the wind"
2. "Thar she blows"
3. "Mess"
4. "Boondocks"
5. "Booby hatch"
6. "Grog"
7. "Brass"
8. "Scuttlebutt"
9. "High Seas"
10. "Log"
11. "Take down a peg"
12. "Davey Jones' locker"
13. "When my ship comes in"
14. "Limey"
15. "Landlubber"

Page 49: Make a Simple Periscope

1. No. Periscopes give the crew of submarines necessary information without surfacing.
2. "Peri" means around.
   "Scope" means to look.
3. Telescopic lenses allow for distant viewing.
4. They allow for viewing behind lead walls.
5. The gastroscope is used for viewing the stomach.

6 and 7. Answers will vary.

Pages 50-51: Endangered Species of the Sea

1. green turtle
2. blue whale
3. manatee
4. brown pelican
5. sea otter
6. Atlantic salmon
7. polar bear
8. bowhead whale

Page 52: Endangered Species of the Sea

a. Atlantic salmon
b. polar bear
c. brown pelican
d. sea otter
e. manatee
f. green turtle
g. blue whale
h. bowhead whale

Page 55: Careers in Oceanography*

a. physical
b. chemical
c. geological
d. physical
e. biological
f. biological
g. physical
h. chemical
i. physical/chemical
j. biological

1. physical
2. biological
3. physical
4. physical
5. geological
6. physical/geological
7. physical
8. geological/chemical

* There is some overlapping in the use of instruments and the areas of specialization.

THE GROWING FAMILY OF GOOD APPLE PRODUCTS INCLUDES:

☆ ***PERIODICALS*** . . . four to choose from . . . each will bring you a wealth of ideas.

★ **THE GOOD APPLE NEWSPAPER** . . . Ideas! Ideas! Ideas! That is what *The Good Apple Newspaper* is all about. Each issue, and there are five each school year, is a treasure-house of materials for the K-8 teacher. Games, posters, units of learning, task cards, bulletin board ideas, etc. Ideal for all subject areas, adaptable for all grade levels . . . innovative, skill-building, easy-to-use ideas for you and your students.

★ **LOLLIPOPS, LADYBUGS AND LUCKY STARS** . . . And you will thank your lucky stars for finding this newspaper of ideas and activities for teachers of preschool and primary children. Each year there are five 32-page issues chocked full of delightful learning experiences for early learners: patterns, poems, stories, readiness skills, reinforcement activities for all subject areas, arts and crafts, reading, music!

★ **CHALLENGE** . . . **reaching & teaching the GIFTED child**. . . for parents and teachers of gifted, talented and creative children of all ages. Our **CHALLENGE** at Good Apple is to put the world of gifted education at your fingertips-- identification, evaluation, methods of instruction, materials, model programs, units of study, mind benders--with the nation's prominent authorities in the field helping. Joe Wayman, editor.

RAINBOWS, DREAMS AND BUTTERFLY WINGS. . . an exciting religious education publication. Thirty-two cleverly illustrated pages of practical teaching techniques and suggestions for educators teaching in private schools, church programs and parents seeking materials for home use, including Bible quiz activities, creative writing, family worship, bulletin board ideas, posters, music-related fun, Biblical heroes, gameboards, arts, crafts. (K-8)

☆ ***BOOKS***. . . over 250 titles in all subject areas for all grade levels, preschool - 8. Idea books, activity books, bulletin board books, units of instruction all with many reproducible pages.

READING	READINESS	VOCABULARY	SPELLING
BOOK REPORTS	DICTIONARY FUN	LANGUAGE ARTS	CREATIVE WRITING
CREATIVITY	GIFTED EDUCATION	BASIC SKILLS	STORYTELLING
GAMEBOARD IDEAS	POETRY	MATH (all areas)	METRICS
LEARNING CENTERS	CONTRACTS	OUTDOOR EDUCATION	INDEPENDENT STUDY
SCIENCE	SOCIAL STUDIES	SELF-CONCEPT	MEDIA-TELEVISION
ARTS/CRAFTS	PRESCHOOL	PRIMARY	MIDDLE SCHOOL
HOLIDAY IDEAS	BULLETIN BOARDS	TEACHER HELPERS	WORD GAMES
CAREER EDUCATION	PHYSICAL EDUCATION	HEALTH	AWARDS
MOTIVATION	MUSIC	ART EDUCATION	CLASSROOM ENVIRONMENT

GOOD APPLE MIGHT HAVE JUST THE VERY BOOK YOU HAVE BEEN LOOKING FOR!

★ **RECORDS – CASSETTES** . . . a dozen favorites with accompanying activity books.
★ **ACTIVITY POSTERS** . . . over 30 titles each 17" x 22". Your students will love to complete them.
★ **NOTE PADS** . . . 2 dozen choices to reward and motivate. A note for almost every occasion.

☆ ***WORKSHOPS*** . . . Good Apple will provide you with a unique variety of workshops, from gifted education to positive self-concept, from make-it and take-it to major content areas of curriculum. Twenty outstanding consultants are available to meet your needs. All of the Good Apple professionals are experienced teachers and recognized authorities. Our programs include scheduled workshops, special-purpose workshops designed specifically for your school and summer institutes where YOU will be the focus of a 3-5 day involvement experience and have the opportunity for graduate credit. We will work together on providing a workshop to fit your needs! Write to: Good Apple Workshops, Box 299, Carthage, IL 62321-0299 or call Bob Steinman at 217-357-3981.

FOR A FREE CATALOG WRITE: Good Apple, Inc., Box 299, Carthage, IL 62321-0299

ACTIVITIES THAT ARE:

MOTIVATING
SKILL BUILDING
EASY TO PREPARE
EASY TO USE

GOOD APPLE, INC., P.O. BOX 299, CARTHAGE, IL 62321-0299